



Agriculture & Horticulture
DEVELOPMENT BOARD



Grower Summary

TF 191

The effect of ethylene control strategies on the development of rotting in Bramley's Seedling apples

Final 2012

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Before using all pesticides check the approval status and conditions of use.

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Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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HDC is a division of the Agriculture and Horticulture Development Board.

Project Number: TF 191

Project Title: The effect of ethylene control strategies on the development of rotting in Bramley's Seedling apples

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Contractor: East Malling Research

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Previous report/(s): Annual Report 2010

Start Date: 01 April 2009

End Date: 31 August 2012

Project Cost: £48,112

Headline

- The use of either SmartFresh™ or ethylene scrubbing reduces the incidence of scald in long-term CA stored Bramley's seedling apples.
- In situations where the incidence of rotting by *Nectria* are high, ethylene scrubbing is a good strategy for maintaining good fruit quality and helping to reduce rot development.

Background and expected deliverables

Losses due to fungal rots in controlled atmosphere (CA)-stored Bramley can be a significant problem particularly in fruit stored beyond June where losses of 10% or more are not uncommon. Much of the rotting in the later stored fruit is caused by *Nectria galligena*. However, as recent rot surveys have shown, *Fusarium* is also of increasing importance, mainly arising from core rots that result from infection in late blossom.

The introduction of low oxygen storage conditions (5% CO₂ + 1% O₂) have resulted in major improvements in the storage quality of Bramley apples particularly in the control of bitter pit and superficial scald. Using this storage regime, it is not necessary to use the chemical antioxidant diphenylamine (DPA) for control of scald for storage up to six months duration. However, studies have shown that this storage regime also results in an increase in the development of *Nectria* fruit rots, so it is not recommended for orchards with a significant canker problem. Changing the CA conditions to 6% CO₂ + 2% O₂ reduces the rot problem, but increases the risk of scald without DPA treatment.

As the use of DPA is no longer permitted in the UK, storage regimes capable of controlling ethylene and hence scald, become even more important. Two technologies offering ethylene and hence scald control include the use of SmartFresh™ and ethylene scrubbing. Both of these technologies are effective in reducing scald by controlling ethylene but differ in the way in which ethylene is controlled; SmartFresh™ acts by retarding ripening changes such as fruit softening by blocking the ethylene receptor, thereby preventing the auto-stimulation of ethylene production. Ethylene scrubbing removes ethylene from stores once it has been produced. The effect of these two methods of ethylene control on rot development has not previously been studied simultaneously in a commercial environment. Both the technologies have previously been tested in commercial stores. However, a rigorous comparison of these technologies is confounded by differences between stores and differences between the apples stored within them (orchard characteristics, management, growing season etc).

The overall aim of this project was to compare the effects of SmartFresh™ (1-MCP) and ethylene scrubbing (Bi-On (ethylene absorbant) and catalytic scrubbing) on the development

of fungal rots in CA-stored Bramley apples under commercial conditions by assessing fruit from a range of commercial stores. (Note: Originally this project planned to test the use of ozone treatment of stores, but this technology is no longer being used with apples). In addition, a common set of test apples was distributed within the same stores. A parallel set of small-scale trials was also set up within experimental CA chambers at East Malling Research. In both sets of trials fruit inoculated with *Nectria* was included so the effects of the treatments on rot development could be assessed.

Summary of the project and main conclusions

Ethylene scrubbing both by catalytic methods and by potassium permanganate absorption (Bi-On) appeared to be very effective and capable of keeping ethylene levels down to 50 ppb or below. Ethylene concentrations were lower in the Bi-On stores than the catalytic scrubbed stores. The quality of fruit was assessed when the stores were opened and after a subsequent seven days at 18°C. From these assessments and assessments from the small-scale trials that were opened after nine months, the following conclusions are drawn.

For both the commercial store trials and the small scale CA chamber trials, the increase in the rate of rot development in the fruit inoculated with *Nectria* was significantly greater for SmartFresh™-treated fruit (Figure 1). This was expected because as well as triggering ripening, ethylene is involved in the defence mechanisms of fruit against pathogens such as *Nectria*. As SmartFresh™ acts by blocking ethylene production, it will inhibit fruit defence. However, this effect was not accompanied by any observable increase in natural rates of rotting in the commercial stores, so that losses due to rots were the same in stores using ethylene scrubbing and SmartFresh™.

The treatments had beneficial effects on development of physiological disorders. Although in the seasons studied, the incidence of scald in commercial samples were low, the small-scale trial confirmed that both ethylene scrubbing and SmartFresh™ significantly reduce this problem. Senescent breakdown and low temperature breakdown were reduced slightly by scrubbing but significantly by SmartFresh™. No treatment differences were observed for the incidence of CO₂ injury in the commercial trials, but there were indications in the small-scale trial that SmartFresh™ can exacerbate this problem.

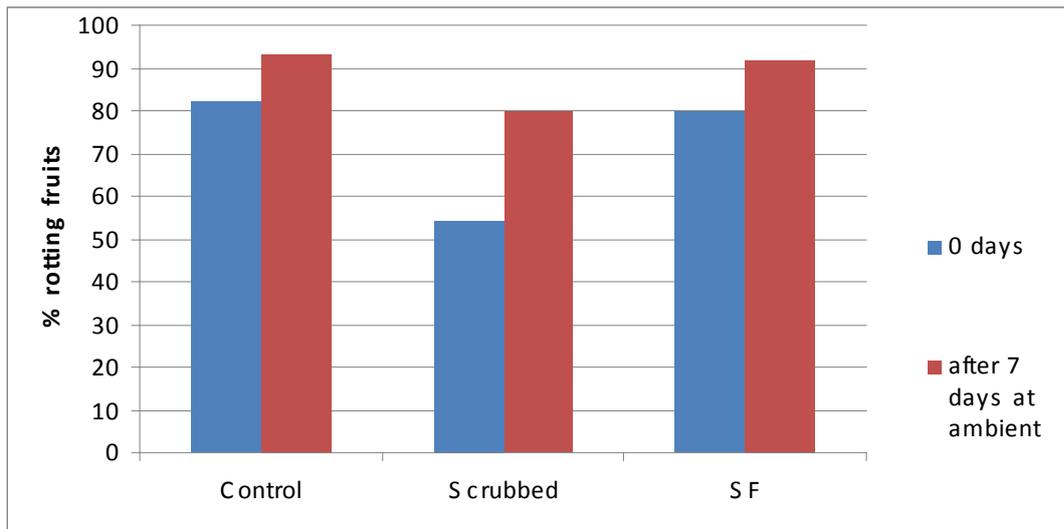


Figure 1: Average % rotting fruits in inoculated nets immediately on removal from storage chambers and after 7 days at 18°C showing that blocking ethylene action by SmartFresh™ can increase rates of rotting, even though other results indicate that this is unlikely to be commercially significant. Treatment effects $p = 0.002, 0.013$ $LSD_{0.05}$ 12.5, 8.6 for 0 and 7 days respectively.

Financial benefits

This project confirms the financial benefits of the use of either SmartFresh™ or ethylene scrubbing to reduce the incidence of scald in long-term CA stored Bramley's seedling apples.

Action points for growers

Where growers have a significant problem with *Nectria* infection in stored Bramley apples, the use of ethylene scrubbing during storage should be considered as a strategy for longer-term storage.