



# **Grower Summary**

---

## **TF 208**

Improving quality of life and extending the storage life of Braeburn and selected new apple varieties through improved storage strategies

Annual 2014

## **Disclaimer**

*AHDB, operating through its HDC division seeks to ensure that the information contained within this document is accurate at the time of printing. No warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.*

*No part of this publication may be reproduced in any material form (including by photocopy or storage in any medium by electronic means) or any copy or adaptation stored, published or distributed (by physical, electronic or other means) without the prior permission in writing of the Agriculture and Horticulture Development Board, other than by reproduction in an unmodified form for the sole purpose of use as an information resource when the Agriculture and Horticulture Development Board or HDC is clearly acknowledged as the source, or in accordance with the provisions of the Copyright, Designs and Patents Act 1988. All rights reserved.*

*AHDB (logo) is a registered trademark of the Agriculture and Horticulture Development Board. HDC is a registered trademark of the Agriculture and Horticulture Development Board, for use by its HDC division. All other trademarks, logos and brand names contained in this publication are the trademarks of their respective holders. No rights are granted without the prior written permission of the relevant owners.*

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

## **Use of pesticides**

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

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

Read the label before use: use pesticides safely.

## **Further information**

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

HDC  
Stoneleigh Park  
Kenilworth  
Warwickshire  
CV8 2TL

Tel – 0247 669 2051

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

<b>Project Number:</b>	TF 208
<b>Project Title:</b>	Improving quality and extending the storage life of Braeburn and selected new apple varieties through improved storage strategies
<b>Project Leader:</b>	Dr Richard Colgan
<b>Contractor:</b>	University of Greenwich
<b>Industry Representative:</b>	Nigel Jenner
<b>Report:</b>	Annual Report 2014
<b>Publication Date:</b>	May 2014
<b>Previous report/(s):</b>	None
<b>Start Date:</b>	1 July 2012
<b>End Date:</b>	30 June 2014
<b>Project Cost:</b>	£55,000

## **GROWER SUMMARY**

### **Headline**

Increasing store oxygen from 1.2% to 1.6% O<sub>2</sub> helps to mitigate symptoms of diffuse core browning during Braeburn storage.

### **Background and expected deliverables**

With increasing volumes of Braeburn being stored, strategies to extend the storage life beyond March would facilitate better scheduling of the crop for the UK market. A previous HDC funded project (TF175) that investigated the effect of different rates of CA establishment in Braeburn storage, found that sealing stores immediately after cooling and allowing fruits to establish 2% O<sub>2</sub> by natural respiration and to maintain this for 10 days before allowing O<sub>2</sub> to drop to a holding CA of 1.2% O<sub>2</sub> <1% CO<sub>2</sub> provided fruit with better ex-store quality compared to a storage regime with a delayed establishment of CA conditions for 21 days. Immediate sealing led to a 3 fold reduction in the incidence of core-flush. However, even with more rapid establishment of CA, it has proved difficult to extend the season beyond March due to a high incidence of core-flush and scald.

There is evidence that the incidence of core-flush is associated more strongly with orchard factors than seasonal variation. Reduced seed set in Braeburn has been linked to poor pollination and is reported to lead to a higher incidence of low calcium senescent disorders. Although core-flush is considered a symptom of senescence, and does not often appear until late in the storage season, it is aggravated by poor ventilation, where a build-up of internal CO<sub>2</sub> and depletion of O<sub>2</sub> through respiration, can lead to localised damage. Compared to other varieties Braeburn has a dense flesh with greater resistance to gas diffusion and a heightened risk of developing a localised build-up of CO<sub>2</sub> as well as depletion of O<sub>2</sub>. It has recently been reported that physiological damage to the core region of Braeburn is due to the development of localised zones of low-oxygen within the flesh of fruit. Adoption of strategies that attempt to lower respiration rate through storage at lower temperatures or through the use of ethylene control strategies may help to reduce CO<sub>2</sub>-injury/core-flush and Braeburn browning disorder (BBD). In addition, storage in higher oxygen concentrations may help to alleviate some of the low oxygen stress type injuries associated with the core region of fruit (Diffuse Core Browning (DCB)/Core-flush).

In addition to testing storage regimes for Braeburn, the project will examine storage regimes for new varieties. With the support of individual marketing groups a small number of CA regimes will be tested for varieties such as Rubens, Opal, Zari and Envy.

Project aim(s): To extend the storage life, marketing season and quality of Braeburn.

Project objective(s):

- 1) To investigate the use of modulation of storage temperature to improve the quality and extend the storage life of Braeburn apples.
- 2) To investigate the use of delayed ethylene scrubbing or delayed SmartFresh™ application to reduce scald development, the incidence of core-flush, Braeburn Browning Disorder (BBD) and carbon dioxide injury in Braeburn apples.
- 3) To investigate whether controlled atmosphere (CA) regimes of 3% O<sub>2</sub> with a 3 week delayed establishment of 0.7 % CO<sub>2</sub> or 2.5% oxygen and 0.5% CO<sub>2</sub> will reduce the incidence of core-flush while maintaining scald control.
- 4) To develop CA regimes for extending the storage life of new varieties.

## **Summary of the project and main conclusions**

This project tested a range of strategies to extend the storage life of Braeburn apples through a reduction in the incidence of core-flush, Braeburn Browning Disorder (BBD) and CO<sub>2</sub> injury. Strategies tested included modulated temperature regimes, incorporating a period of lower temperature (0.5-1.0°C) after a period of standard storage temperature (1.5 – 2.0°C) and secondly, delayed ethylene scrubbing and SmartFresh™ application targeted to coincide with the final establishment of CA atmosphere of 1.2% O<sub>2</sub>.

Many of the internal core browning problems (diffuse core browning (DCB) that can develop into core-flush) have been previously attributed to a localised depletion of oxygen within the core region. It was anticipated that the incidence of this disorder could be reduced by storing in the higher oxygen regimes used in some parts of Northern Europe including storage in 3% O<sub>2</sub> with a 3 week delayed establishment of 0.7 % CO<sub>2</sub> or a 2.5% O<sub>2</sub> with delayed establishment of 0.5% CO<sub>2</sub>. These regimes were tested in this project. An additional CA treatment where an incremental rise in oxygen from 1.2% to 2% after 70 days followed by a further increase of store oxygen to 3% after 210 days was also tested to determine if this strategy would reduce the incidence of BBD and DCB/Core-Flush.

## Conclusions

- In the first year of the trial the incidence of BBD was closely related to harvest maturity of fruit entering store. Fruits with an advanced state of maturity and higher fruit respiration had a significantly higher risk of developing the disorder.
- DCB was influenced strongly by orchard factors. However, storage in low oxygen (1.2% O<sub>2</sub>) exacerbated the disorder.
- From the results of the first year of the trial, in orchards with a history of BBD and DCB/ core-flush; storage at 1.6% Oxygen or 1.2% oxygen with modulated storage temperature may help to reduce the incidence of the disorders. These regimes were also preferred for retaining background green colour.
- Combining CA storage in 2% oxygen and delayed ethylene removal or SmartFresh™ did not elevate the rate of BBD.
- Storage at oxygen concentrations above 2% failed to control BBD or DCB.
- Maximising CO<sub>2</sub> scrubbing from the storage environment in commercial fruit stores will help reduce the incidence of internal browning. Concentrations <0.5% CO<sub>2</sub> are beneficial.
- It is important to note that, where a known orchard history of these conditions (BBD and DCB/Core-Flush) prevail, long-term storage is not recommended.
- Data from storage trials of new varieties was made available to individual marketing groups associated with the variety in question.

## Financial benefits

Reducing the incidence of internal browning problems in Braeburn may afford the opportunity to extend the marketing window for Braeburn.

## Action points for growers

- Late picking of Braeburn can increase the incidence of internal browning.
- Ensure fruit have good mineral nutrition with calcium and boron at or above the recommendations for Cox calcium (5 mg 100g<sup>-1</sup> FW) and boron (2.5 mg 100g<sup>-1</sup> FW).
- Storage at 1.6% O<sub>2</sub> helps to reduce the overall incidence of browning compared to 1.2 % O<sub>2</sub>.