Grower Summary

TF 208

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

Final 2014

Disclaimer

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.

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

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Contractor/(s):	University of Greenwich
Industry Representative:	Nigel Jenner
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Further information

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GROWER SUMMARY

Headline

- During the first four months of Braeburn storage, 1.6% O_2 helps to reduce the overall incidence of diffuse core browning compared to 1.2 % O_2.

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) investigated the effect of different rates of CA establishment in Braeburn compared to delayed establishment for 21 days. Fruit with better ex-store quality was achieved by sealing stores immediately after cooling and allowing fruits to establish 2% O_2 by natural respiration and by maintaining this for 10 days before allowing O_2 to drop to a holding CA of 1.2% O_2 <1% CO_2. Immediate sealing led to a three-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 often does not appear until late in the storage season, it is aggravated by poor ventilation, where a build-up of internal CO_2 and depletion of O_2 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_2 as well as depletion of O_2. 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_2-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 it was planned to investigate storage regimes for new varieties. With the support of individual marketing groups a small number of CA regimes will be tested for Rubens, Opal, Zari and Envy.

Overall aim of project

- To extend the storage life, marketing season and quality of Braeburn and selected new varieties.

Specific Objectives

- To investigate the use of a range of storage strategies to improve the quality and extend the storage life of Braeburn and selected new varieties; eg. Rubens, Opal, Zari and Envy.

For Braeburn the storage regimes to be tested would include:

- Modulation of storage temperature.

- Delayed ethylene scrubbing or delayed SmartFresh™ application. (It is anticipated these strategies will reduce fruit respiration rate during long-term storage and lead to a lowering in the incidence of core-flush).

- Controlled atmosphere (CA) regimes of 3% O_2 with a 3 week delayed establishment of 0.7 % CO_2 or 2.5% oxygen and 0.5% CO_2.

- Extending the storage-life of air-stored Braeburn through the delayed application of SmartFresh™ or ethylene scrubbing in 2 % oxygen.

Summary of the project and main conclusions

In year 1 of the project, storage of Braeburn in 1.6% O_2 provided a better overall control of internal browning conditions than 1.2% O_2. Equally the modulated temperature regime of 1.2 % O_2 with storage for five months at 1.5-2.0°C followed by two months at 0.5-1.0°C provided a marginal improvement in quality over the standard storage regime (1.2% O_2 1.5-2.0°C). Storing fruit in less stringent conditions has been successfully used to reduce the incidence of water core symptoms in Cox and Bramley. Raising store oxygen from 1.2 to 1.6% O_2 reduced the severity of DCB in the early stages of storage in year 2 but failed to reduce the number of fruits going onto develop core-flush later in the storage season.

In the first year of the trial increasing oxygen above 2% did not reduce the amount internal browning. In the absence of ethylene control strategies, fruits softened more during shelf-life in late-stored fruit. Although the use of delayed SmartFresh™ application helped to contain late season softening, it exacerbated internal browning. Incremental increase of oxygen from 1.2 to 2% up to 3% by the end of storage also failed to limit internal flesh browning.

Lowering the temperature has in the past been used to reduce internal browning in fruit. However, in this trial, where fruits were stored for longer than two months in 0.5-1.0°C, the incidence of core-flush was increased in long-term stored fruit. Continuous exposure to low temperatures is known to induce core-flush but temperature modulation for shorter periods was considered to be a safer option that may help to reduce internal browning.

In parallel trials funded by the University of Greenwich, dipping fruit in the anti-oxidants helped to reduce core-flush in Braeburn and similar effects have been reported on Bramley (Johnson and Colgan 1996). While the use of antioxidants is no longer permitted, reducing oxidative processes by use of extremely low oxygen storage can help to reduce the incidence of core-flush development.

Main conclusions

- The incidence of Braeburn browning disorder and core-flush were 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 disorders.
- Diffuse core browning was influenced strongly by orchard factors. The severity of diffuse core browning was lower when fruits were stored at 1.6% O_2 (1.5-2.0°C) in the early stages of the storage season.
- Fruits stored in 1.6% O_2 had slightly lower background green colour.
- Fruits with higher calcium content (7 mg 100^{-1} g) were less prone to developing core-flush.
- Modulated storage temperature offered little benefit and extending exposure to 0.5-1.0°C beyond two months increased the risk of core-flush.
- Combining CA storage in 2% oxygen with delayed ethylene removal or SmartFresh™ did not control BBD.
- Storage at oxygen concentrations above 2% failed to control BBD or core browning.
- Maximising CO_2 scrubbing from the storage environment in commercial fruit stores will help reduce the incidence of internal browning. Concentrations <0.5% CO_2 are beneficial.

- It is important to note that long-term storage is not recommended in orchards with a history of developing these disorders.

Data from storage trials of new varieties was made available to individual marketing groups associated with the variety in question.

A more detailed account of the regimes investigated and the results achieved can be found in the Science Section of this report.

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.
- Standard harvest maturity parameters are not always sufficient to accurately predict the physiological maturity of Braeburn.
- Ensure fruits have good mineral nutrition with calcium and boron at or above the recommendations for Cox.
- During the first four months of storage, 1.6% O_2 helps to reduce the overall incidence of diffuse core browning compared to 1.2 % O_2.
- Storage at 1.6% O_2 may help to alleviate the glassy water core type symptoms associated with diffuse core browning, allowing more of the solutes trapped in the air spaces between cells to be taken up by adjacent cells.
- Storage at 1.6% O_2 rather than 1.2% O_2 results in slightly higher loss of green background colour.
- Storing Braeburn at 0.5-1.0°C for longer than 2 months increases the risk of core-flush.