

Ethylene removal from a commercial Bramley apple store

David Bishop, Technical director ICA Ltd, Paddock Wood, UK
Roger Manning, Manning Farms, Wisbech, UK

This trial, on a commercial farm with commercial fruit, was set up to assess the effectiveness of ethylene removal on the storage life and quality of Bramley apples in CA storage. A comparison is made with other fruit in the same farm and storage complex that have been treated with 1-MCP. No DPA drench was used in either of the storage regimes.

Fruit used

The trial store of volume 341 M3 was filled with 85 tonnes of Bramley apples picked between 29th August and 3rd September. The fruit was picked from orchard A that has a past history of being the worst orchard in the farm for storage rots. The 1-MCP rooms were picked at about the same time but were from different orchards with a history of less rotting in store than orchard A. It was not possible to use the same orchard for comparison due to commercial constraints.

Ethylene removal

The ethylene was removed in store using the Bi-On 4 Air purification system. This system uses pellets of specially formulated zeolite clays impregnated with Potassium Permanganate. The pellets are contained in polystyrene PP12 filter cartridges each containing 13.5 Kg of pellets. These cartridges are produced in a V format to maximise the efficiency of the air flow across the pellet surface. A cut away view is shown in this photo.



This store is equipped with a tower cooler, with the air being discharged from the cooler tower at ceiling level over a horizontal angle of 180 degrees.

The photo shows a partially emptied store with the cooler outlet visible.

6 Cartridges were placed in the air stream in the space between the top of the bins and the ceiling at a distance of 2-3 bins from the cooler outlet. The V section was positioned in the direction of the air flow. The typical air velocity at the position of the filters was between 2 and 4 m/sec. The room refrigeration is operated for 7 hours every day with the fans switched to run for 5 minutes every hour when the refrigeration is off.

Storage conditions.

The test room was loaded on the 29th August and the storage temperature of 4.5° C was achieved on the 30th August. The room was sealed on the 13th

September and Oxygen below 5% was obtained on 27 September. The room was controlled at 2% oxygen and 6% CO₂ from 3 to 14 October at which time it was reduced to 1% Oxygen and 5% CO₂ until the room was opened on the 4 June. This is a storage time of 9 months.

During this time the ethylene was measured every hour with an ICA518 ethylene monitor attached to the automatic ICA61 CA control and measuring system.

After the room was sealed, the ethylene remained consistent at 0.5 ppm with a typical measurement variation of +/- 0.2ppm

The adjacent room was kept at the same temperature and CA conditions but with 1-MCP treatment and no ethylene removal. The ethylene levels at the beginning of the storage period was 0.5ppm increasing through the season to 1.6 ppm at the time of opening.

[Other work measuring the ethylene in Bramley stored in DPA treated rooms without 1-MCP or ethylene removal was about 30ppm at the traditional 9% CO₂ atmosphere and 15 to 20 ppm in 1% Oxygen and 5% CO₂ rooms.]

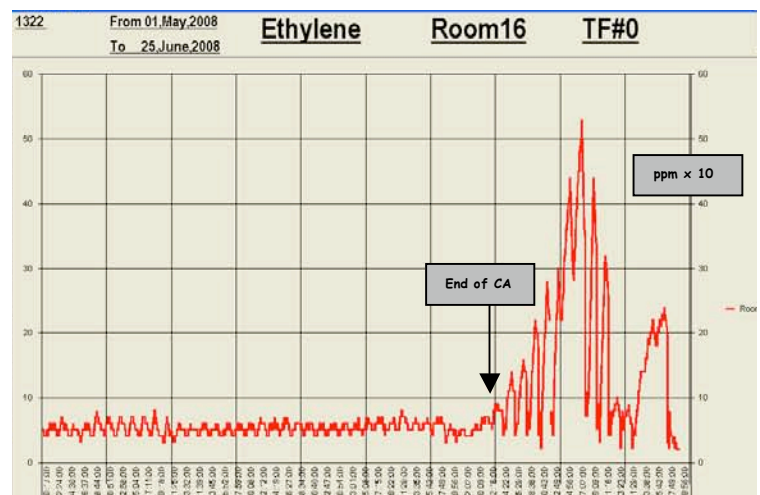
Internal Ethylene.

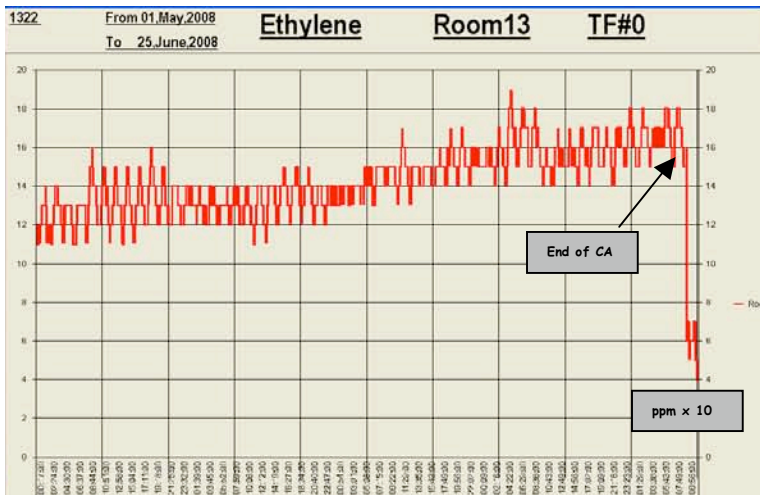
Concern was expressed that ethylene removal reduced the atmospheric ethylene but did not control the fruit internal ethylene in the same way as 1-MCP.

Sample fruits from the Scrubbed room and the 1-MCP treated room were removed on 24 April and analysed within 24 hours. There was no statistical difference between the samples which had typical levels of 30ppb.

Ethylene at end of CA storage.

At the end of the CA storage period the room was ventilated with air and the ethylene continued to be monitored as the room was unloaded. The ethylene in the Bi-On room increased significantly during the night when the doors were shut as shown in the graph for room 16. In the room with 1-MCP treatment shown in graph for room 13, when the room is ventilated the ethylene falls from 1.6ppm to about 0.5 and remains low. This is a clear indication that with ethylene scrubbed rooms the ethylene producing potential within the fruit is still active and starts up again once the low oxygen atmosphere is released.





These graphs are direct plots from the ethylene recording section of the ICA61 CA control and measuring system and show the consistent 0.5ppm from the Bi-On room and the 1-MCP room increasing from 1.2 to 1.6 ppm ethylene during this same period.

Fruit Quality measurements.

The fruit was subject to the usual commercial periodic QC tests. The results are shown in the chart below and compared with fruit from the same orchard in the previous season.

	With 1-MCP 2006/7	With Bi-on 2007/8
	Pressure Kg	Pressure Kg
Oct		9.32
Nov	8.50	9.31
Dec	8.60	8.95
Jan	8.37	8.96
Feb	8.82	
March	8.42	8.59
April		8.50

Grade out results

With the exception of the rots the fruit from the scrubbed room was of high quality with no scald and no CO2 injuries.



Rotting

The number of rots was significant, but at about 50% of the level of fruit from the 1-MCP treated room opened 5 days after the test room. This cannot be seen as conclusive because the fruit was from a different orchard, however the test fruit came from an orchard that in previous years had shown significantly greater rotting potential and is considered a very good indication that the use of the Bi-On air purification system significantly reduces in-store rotting. The majority of the rotting was *Nectria core rot*



Ethylene adsorption capacity

Samples of the Bi-On adsorption pellets were removed and analysed for remaining capacity. It is estimated that the total amount of ethylene adsorbed was 260 L. This is equivalent to an overall ethylene production rate of 0.47 uL/kg/hr. There was an adsorbing capacity remaining within the cartridges of approximately 30 %

These figures however cannot be directly used to determine the quantity of material needed for a shorter period as it is our experience from other work that a significant amount of the removal takes place in the early part of the storage period and reduces as time progresses. We also know that it is essential to have enough adsorption capacity at the beginning of storage to prevent the start of any significant ethylene production.

Conclusions:

The control of ethylene in the atmosphere of a low oxygen Bramley apple store using the Bi-On air purification system gave storage outcomes at least as good as treatment with 1-MCP with no evidence of scald or CO₂ damage.

For Bramley apples stored in low oxygen the recommended quantity of Bi-On 4 material is 1kg/tonne of storage or one P12 module per 15 tonnes of fruit

It is felt from experience and observation that Bi-On air purification reduced the storage rots by a significant amount. Further work with fruit from the same orchard in both treatments is needed to be able to confirm this.

The ethylene production rate of Bramley's stored under low oxygen conditions when picked at the recommended times is low.

It is essential to have sufficient ethylene removal capacity to fully control ethylene at the beginning of the storage period.

The Bi-on system of ethylene control is both adequate and cost effective for use in low Oxygen Bramley storage.

The retention of the ethylene production capacity at the end of the storage period for the Bi-On fruit compared with the 1-MCP indicated that further work comparing flavour development after storage would be worthwhile.

The ICA ethylene measuring system can be used to reliably measure ethylene in storage rooms to levels lower than 0.5ppm and is proving a good tool for checking the ethylene concentration in apple storage rooms that have some form of ethylene control.

Acknowledgments:

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