



# **Grower Summary**

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## **TF 201**

Improving quality and  
reducing costs of  
Conference pear storage  
using SmartFresh™

Final 2013

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HDC  
Stoneleigh Park  
Kenilworth  
Warwickshire  
CV8 2TL  
Tel – 0247 669 2051

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

**Project Number:** TF 201

**Project Title:** Improving quality and reducing costs of Conference pear storage using SmartFresh™

**Project Leader:** Richard Colgan, Natural Resources Institute (NRI), University of Greenwich

**Contractor:** NRI

**Industry Representative:** Nigel Bardsley

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**Start Date:** 1 August 2011

**End Date:** 31 July 2013

**Project Cost:** £32, 066

# **GROWER SUMMARY**

## **Headline**

- Improvement in the long-term-storage quality of Conference pears stored at  $-1.0^{\circ}\text{C}$  may be achieved by application of half rate SmartFresh™

## **Background and expected deliverables**

With the granting of an EAMU for SmartFresh™ (1-MCP) on pears, opportunities exist to explore the modification of existing storage recommendations for Conference pears. Early experience with SmartFresh™ on Conference has found that pears often fail to ripen properly after removal from store and in some cases have lost their ability to respond to ripening cues. Nevertheless subsequent experimental trials conducted on behalf of Agrofresh have indicated that by modifying storage temperature, or reducing application rates from the usual recommended concentration of 625 ppb to 325 ppb, Conference pears retain their ability to ripen. The introduction of a low concentration of external added ethylene during SmartFresh™ treatment has produced promising results.

The current recommendations for pear storage require rapid cooling to remove the field-heat and reduce fruit temperature to  $4^{\circ}\text{C}$  within two to three days of store loading followed by a further reduction to  $-1^{\circ}\text{C}$  within seven to ten days of loading. In some cases rapid cooling to  $-1^{\circ}\text{C}$  has been difficult to achieve, particularly in older stores. Such low storage temperatures can lead to fruit stalk end shrivel in some stores. To avoid this, bins can be covered but this further increases storage costs.

The introduction of new protocols to counteract the problems associated with SmartFresh™ and delayed ripening, offer the opportunity of further research to improve pear quality and extend storage-life.

It is worth researching the effect of reducing the dose of SmartFresh™ currently recommended (625 ppb), or to store at higher temperatures than currently recommended. Reducing the dose rate to 325 ppb has been found to be effective where pear maturity is clearly defined and pears are to be marketed after six and nine months storage.

The most effective protocol must evaluate not only the propensity to ripen ex-store, but also the amount of shrivel, background colour and the incidence of rotting, both ex-store and during shelf-life.

The effect on pear storage life of ethylene removal during storage has also be tested. The project aims to improve fruit quality and reduce costs of Conference pear storage by using SmartFresh™. Key to achieving this aim will be the identification of protocols whereby pears retain their ability to ripen following SmartFresh™ treatment.

Specific objectives are:

1. To identify an optimum method of SmartFresh™ treatment and storage for Conference pears.
  - 1.1 To identify the optimum storage temperature following an application of SmartFresh™.
  - 1.2. To assess the effects of exposure of fruit to low concentrations of external ethylene in conjunction with SmartFresh™ treatment with a view to maximising the benefits of objective 1.1.
  - 1.3. To compare the effect of SmartFresh™ application with ethylene scrubbing during storage.
2. To quantify the economic benefits of the identified optimum method of post-harvest treatment and storage.
3. To disseminate results obtained through publications, the EMRA members day on fruit storage and training days where appropriate.

## Summary of the project and main conclusions

### Year 1 (2011-2012)

In the first year of the trial Conference pears were harvested from two orchards (referred to as Orchard 39 and Orchard 40) in Kent on the 1<sup>st</sup> September 2011 and transported to the Produce Quality Centre at East Malling Research. After 48 hours of cooling, SmartFresh™ was applied at the temperatures and application rates outlined in the table below with or without the addition of ethylene. In the first year ethylene scrubbing using sheets impregnated with E<sup>+</sup> formulated palladium catalyst was also tested:

Treatment	Code	Temperature regime		
		-0.5 to -1°C	0.5 to 1.0°C	1.5 to 2.0°C
Control, no treatment	C	√	√	√
24 h treatment with SmartFresh™ (625 ppb)	A	√	√	√
24 h treatment with SmartFresh™ (625 ppb) in the presence of 300 ppb ethylene.	B1		√	√
24 h treatment with SmartFresh™ (625 ppb) in the presence of 600 ppb ethylene	B2		√	√
24 h treatment with SmartFresh™ (625 ppb) in the presence of 900 ppb ethylene	B3		√	√
24 h treatment with SmartFresh™ (312 ppb)	D	√	√	√
Ethylene scrubbing by E+ (palladium based) throughout storage period	E		√	√

The results from the 2011/2012 season indicated that extending the storage period for Conference pear beyond the existing six-month window is most likely to be achieved through storing at lower temperatures of 1°C or less. Two contrasting orchards were included in these trials. The effectiveness of SmartFresh™ varied according to orchard; SmartFresh™-treated fruit from Orchard 40 softened at a slower rate than Orchard 39.

Storage at 1.5-2.0°C led to a loss of firmness during prolonged storage in both orchards and SmartFresh™ failed to maintain firmness above the commercially acceptable threshold (60N) after three months of storage. More importantly, a rapid loss of background green colour was observed in fruit from all treatments stored at 1.5-2.0°C along with a greater incidence of post-harvest rotting in fruit stored beyond three months. In addition, internal carbon dioxide injury was present in fruit inspected after nine months of storage.

The ex-store firmness of pears stored at 0.5-1.0°C and -0.5 to -1.0°C during the first six months of CA storage were similar and no treatment differences between SmartFresh™ and control fruit were observed. Maintaining the firmness of pears long-term required storage at the standard -0.5 to -1.0°C regime. However, there was little significant effect of SmartFresh™ on ex-store firmness of Conference pears during extended periods of storage. The rate of softening of pears during the shelf-life period was influenced by SmartFresh™ and the duration of storage. Pears entering shelf-life after three months of storage exhibited a one to two day delay before changes in firmness were observed. Pears treated with SmartFresh™ (625 ppb) softened at a slower rate between two and six days. The delay in softening was more pronounced in fruits stored at lower temperatures. However, fruits from each treatment reached an eating quality firmness of 1.5 kg by between five and seven days. Pears entering shelf-life after six or nine months storage showed no delay in softening and at this stage in the storage life, SmartFresh™ was only marginally effective at delaying softening during shelf-life of pears from Orchard 40.

### **Year 2 (2012-2013)**

In the second year of the trial, three separate orchards (BG, BE and LB) were selected and SmartFresh™-treatments were applied at two temperatures (-0.5 to -1.0°C and 0.5-1.0°C), in accordance with the treatment plan below.

		-0.5 to -1°C	0.5 to 1.0°C
Control, no treatment	C	√	√
24 h treatment with SmartFresh™ (625 ppb)	A	√	√
24 h treatment with SmartFresh™ (625 ppb) in the presence of 300 ppb ethylene.	B1		√
24 h treatment with SmartFresh™ (625 ppb) in the presence of 600 ppb ethylene	B2		√
24 h treatment with SmartFresh™ (625 ppb) in the presence of 900 ppb ethylene	B3		√
24 h treatment with SmartFresh™ (312 ppb)	D	√	√
Ethylene scrubbing by Potassium Permanganate throughout storage period	E		√

Fruits were inspected for external and internal quality after three, six and nine months storage. After each inspection, fruits were subject to eight to twelve days of shelf-life testing at 18°C. Conference pears from the three orchards behaved in a similar fashion during

storage. Results of these trials show that storage temperatures influence the rate of softening during shelf. In the absence of SmartFresh™, pears stored previously at -1.0°C softened more slowly during shelf-life than fruit stored at 0.5-1°C. The application of half-rate (325 ppb) SmartFresh™ to Conference pears stored at -1°C and +0.5-1°C slowed the rate of softening decline during shelf-life with fruit reaching an eating firmness of 1.5 kg after 8 days of shelf-life. Application of full rate SmartFresh™ (625 ppb) prevented ripening during shelf-life. This impedance could be overcome by the addition of a small dose of ethylene at the time of SmartFresh™ application, but we observed that ethylene treatments also increased the incidence of rotting.

The benefit of increasing the storage temperature for pears has yet to be evaluated fully. While raising storage temperatures may offer a cost saving to growers, it is important that the quality of fruit is not compromised. Half-rate SmartFresh™ controlled the rate of softening during shelf-life of fruit stored at 0.5-1.0°C. However, after six months storage the incidence of rotting in pears (6.1%) was greater than the 2.7% rotting observed in fruit stored at -1.0°C.

The potential of extending the storage life of pears beyond the existing March/April termination date (six months) is only possible if the incidence of rotting can be controlled. In these trials, the amount of rotting in pears stored for nine months at -1.0°C reached 12 % and increased to 19.4% in fruit stored at +0.5-1.0°C. However, with pears stored for nine months at -1.0°C, the application of SmartFresh™ at half or full rate slowed the rate of softening during shelf-life and both SmartFresh™ treatments reduced the incidence of internal discolouration, while SmartFresh™ applied at half-rate provided fruit with a better eating quality.

The conclusion of these trials is that half-rate SmartFresh™ applied to fruit stored at -1.0°C can help to manage shelf-life ripening for fruits destined for storage until March/April (six months). While the use of SmartFresh™ to extend Conference pear storage beyond the current termination date looks promising, further studies are required to fully evaluate this treatment.

## Conclusions

- Where fruits are destined for long-term (six months) storage at -0.5°C to -1.0°C then application of half rate SmartFresh™ can help manage the rate of softening during subsequent shelf-life.
- Storage of pears at -0.5 to -1.0°C beyond six months can lead to increased incidence of rotting and in some consignments increased internal browning which may be addressed by post-harvest drenching in Rovral.

- SmartFresh™-treatment of Conference pear fruit at 0.5-1.0°C has provided some promising results but further work needs to be replicated on a larger scale before any recommendations can be made.
- The higher rate of rot development in Pears stored at 0.5-1.0°C is a concern and needs to be addressed before storage at higher temperature is considered on a commercial basis.

### **Financial benefits**

- Application of half rate SmartFresh™ can slow down the rapid decline in firmness during shelf-life.

### **Action points for growers**

- Improvement in the long-term-storage quality of Conference pears stored at -1.0°C may be achieved by application of a half rate SmartFresh™.
- Fruits need to be of sufficient maturity, above 12.3% Brix before treating with SmartFresh™, to allow fruits to ripen fully on removal to shelf-life conditions.
- Early removal (December) from store of SmartFresh-treated fruit will result in fruit taking longer (10-12 days) for pears to achieve an acceptable eating quality firmness of 1.5 kg.