



Grower Summary

TF 225

**Developing Practical Strategies to
Improve Quality and Storage
Potential of UK Apples**

Annual report 2018

Project title: Developing Practical Strategies to Improve Quality and Storage Potential of UK Apples

Project number: TF225

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Report: Annual Report October 2018 (for 2017)

Previous report: Annual Report October 2107 (for 2016)

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Location of project: NIAB/EMR, FAST LLP, Selected Gala orchards in Kent

Industry Representatives: Nigel Jenner, Paul Smith and Nigel Stewart

Date project commenced: 1 April 2016

Date project completed 31 March 2021

(or expected completion date):

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The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.


AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headlines

- The position of fruit within the tree canopy influences the accumulation of fruit dry matter content.
- Fruit with higher dry matter entering storage maintained higher °Brix throughout Controlled Atmosphere storage (3% CO₂: 2% O₂).
- An increase in light penetration and interception was recorded in centrifugal pruned trees, but it was too early to see changes in Fruit Dry Matter.
- A weak correlation occurred between higher K and Mg and increases in Fruit Dry Matter.
- Chlorophyll fluorescence has the potential to track changes in harvest maturity.

Background and expected deliverables

Fruit dry matter (FDM) content is considered a good indicator of high sugar and acid content (°Brix) and eating quality of apples at harvest. Apples high in FDM tend to retain quality attributes over extended periods of storage. The extent to which orchard management practices during flower bud and fruit development affect FDM at harvest requires further attention. Moreover, the relationship between FDM and fruit quality ex-store throughout the storage season, is of interest to the UK apple industry and may afford the opportunity to identify orchard consignments that can be stored for longer.

Several research groups, including the work of Palmer (1999) in New Zealand, have linked high FDM at harvest to good quality and good storage potential. These studies were reviewed in AHDB Horticulture Project TF 222, and although previous research highlights the potential to use FDM as a proxy measure of fruit quality, much of this work was correlative.

The underlying basis of this relationship needs to be better understood so that it can be manipulated to deliver premium fruit quality. This project set out to improve our understanding through a series of Work Packages:

1. A meta-analysis of existing data sets to obtain a greater understanding of the factors controlling both FDM and quality
2. The effect of reflective mulches and novel pruning strategies on light interception in the crop canopy and its effect on FDM
3. Manipulation of crop load through bud and fruit thinning to assess impact on FDM and help growers to improve the quality of stored apples.

In addition, the project set out to investigate a new method of recording fruit maturity using chlorophyll fluorescence (Work Package 4) to improve the methods for predicting the optimum date for picking fruit destined for long-term storage.

Summary of the project and main conclusions

Meta-analysis of data sets

Meta-analysis (Work Package 1: UoG / FAST LLP / NIAB EMR) for the two years of FDM data for commercial Gala and Braeburn orchards identified 56 Gala orchards where mineral analysis (soil or leaf) existed to allow

some correlative analysis of FDM against soil and leaf quality attributes. Use of multiple regression linear models revealed a weak positive relationship between fruit Potassium and Magnesium concentrations and FDM and a negative relationship with Zinc.

The effect of reflective mulches and novel pruning strategies on FDM

Conversion of tall spindle (TS) trees to a centrifugal growth habit was undertaken in the winter of 2016 as part of Work Package 2 (NIAB EMR). In the first year of conversion, Centrifugal System (CS) increased light interception with 41.5% of external light compared to 34.4% in the tall spindle system. In the first year, yields in CS trees were lower - 45 kg/tree compared to 61 kg/tree in TS trees, but it is anticipated that yield will increase as future pruning of CS trees will be minimal. The use of reflective covers increased yields in CS trees by 5% and TS trees by 19% exemplifying the benefits of increased light penetration and interception on fruit production. The proportion of Class I fruit was 84.5% in CS trained trees compared with 80.9% in TS systems.

Manipulation of crop load through bud and fruit thinning

In the second year of Work Package 3 (FAST LLP / UoG), a series of bud, flower and fruitlet thinning practices were implemented using the following treatments:

- T1: Untreated Control – no thinning
- T2: Bud Thinning - buds were removed in late March at BBCH 52-54 (end of bud swelling to mouse ear)
- T3: Mechanical Thinning – in April using a hand held Electroflor machine applied at BBCH 65-66 (60% first open flowers)
- T4: Chemical Thinning - Exilis (6-Benzyladenine) + Fixor applied in May at BBCH 70-72 (funded by Fine)
- T5: Chemical Thinning - Brevis (150 SG metamitron) applied in May at BBCH 70-71 & 71-72 (funded by Adama)
- T6: Standard Hand Thinning – removal of fruitlets to doubles & singles within clusters, applied at BBCH 71-72 (fruit size 15mm to 25mm, pre/up to second fruit fall)
- T7: Hand Thinning Size – removal of fruitlets based on size category starting at BBCH 73, event 1 fruit size 25mm to 30mm, event 2 fruit size 40mm (BBCH 74).
- T8: Late Hand Thinning treatment - BBCH 73-74 (fruit size 30mm to 40mm, after second fruit fall)

No treatments significantly increased FDM at harvest in the first year. Application of Brevis led to a doubling of fallen fruit (237/tree) compared to the control (115/tree) and represented 20% of the total fruit on the tree. Standard hand thinning and late season thinning led to more fruits being physically removed than thinning to size. None of the treatments significantly affected yield or the proportion of Class 1 fruit. In 2017 the trial trees were subjected to frost damage so it is likely that treatment differences may have been suppressed by the higher volume of natural flower/fruit drop.

Chlorophyll fluorescence as a system for predicting optimum picking dates

For Work Package 4 (Landseer Ltd), Chlorophyll fluorescence (CF) modelling was successful in predicting the onset of harvest maturity by 7 to 10 days in advance of starch clearance patterns reaching 75-80% in six commercial Gala orchards.

Advanced warning of the onset of starch clearance would allow growers more time to organise harvest and increase the likelihood of a greater proportion of the first picked Gala crop being harvested within the short window necessary to ensure fruit are suitable for long-term storage. Chlorophyll fluorescence modelling was successful in predicting the onset of harvest maturity by 7 to 10 days in advance of starch clearance patterns reaching 75-80%. Landseer monitored changes in CF profiles in six commercial Gala orchards starting from mid-July, at fruitlet stage, through August and again at harvest. While optimising harvest maturity is important for selecting orchards for long-term storage, fruits need to have adequate balance of mineral nutrition and good FDM to improve the chances of fruits retaining quality for longer in store.

Chlorophyll Fluorescence affords an opportunity to provide information to growers regarding changes in fruit maturity in advance of changes in starch clearance patterns. Analysis of CF outputs from six commercial orchards found that on average CF outputs could predict the decrease in starch to 75% content 7 to 10 days before the event. Further work is ongoing to determine the impact of early warning and potentially more precise harvesting forecasting on the storage quality of fruit.

Main conclusions

Year 2 of this study attempted to maximise Fruit Dry Matter (FDM) in Gala by manipulating crop load through bud and fruitlet thinning practices and increasing light interception by the tree canopy by manipulating tree architecture through imposing novel centrifugal training systems in conjunction with positioning of reflective covers in alleyways. In this initial year of conversion centrifugal pruning increased light interception through the canopy but it was too early in the conversion process to observe an increase in FDM. Manipulation of crop load, while affecting yield and the proportion of class I fruit, did not lead to an increase in FDM.

Statistical analysis of a large data set provided by FAST LLP, indicated a small positive correlation between higher fruit K and Mg content and higher FDM.

The use of a chlorophyll fluorescence and subsequent data modelling provided a 7-10 advanced warning on changes in starch clearance patterns that are used by the industry as a measure of advancing fruit maturity and the need to the start of harvesting.

Financial benefits

No financial benefits have been identified to date.

Action points for growers

- Harvesting fruits higher in the canopy separately will provide consignments with higher FDM.