



Grower Summary

TF225

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

Annual report 2019

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 2019 (for 2018)

Previous reports: Annual Report October 2018 (for 2017)
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 (or expected completion date): 31 March 2021

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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.

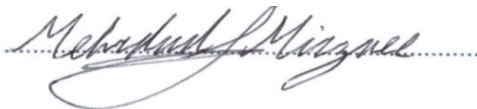
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GROWER SUMMARY

Headline

- Chlorophyll fluorescence can give 7-10 days advance warning of starch clearance patterns reaching 75-80%.

Background and expected deliverables

Fruit dry matter (FDM) content is considered a good indicator of high sugar and acid content (% Brix^o) 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 affects FDM at harvest requires further attention. Moreover, the relationship between FDM and fruit ex-store quality 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 highlighted 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. In this project, it is hoped to achieve this through a combination of a meta-analysis of existing data sets to obtain a greater understanding of the factors controlling both FDM and quality, and the development of practical strategies in terms of novel pruning strategies, reflective covers and manipulation of crop load through bud and fruit thinning to help growers to improve the quality of stored apples.

Year 3 of this study (2018) attempts to maximise Fruit Dry Matter (FDM) in Gala apples by manipulating crop load and increasing light interception through the canopy. Bud, flower and fruitlet thinning practices, using mechanical and chemical thinning treatments (Exilis and Brevis), were employed by the scientists to manipulate crop load. Parallel work utilised novel centrifugal pruning techniques to increase light interception throughout the tree in conjunction with positioning of reflective covers in alleyways to redirect light back into the lower canopy.

Summary of the project and main conclusions

Meta-analysis (Work package 1)

In the first two years of the project, meta-analysis 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. Using multiple regression linear models revealed a weak positive relationship between fruit potassium and magnesium concentrations and FDM and a negative relationship with zinc.

Influence of light interception on FDM (Work package 2)

Conversion of tall spindle (TS) Gala trees to a centrifugal growth habit was undertaken in the winter of 2016 as part of WP2. In the 2018 season, centrifugal pruning and the positioning of reflective covers in the alleyways increased light interception through the canopy. Higher temperatures resulted, particularly in tall spindle trees where reflective covers raised internal canopy temperatures by 2.6°C and led to a slightly faster rate of fruit expansion (non-significant). The exceptionally warm temperatures in 2018 with above average sunshine hours, led to fruit with high %FDM (~17.0%) across the canopy, so the experimental treatments did not increase %FDM. Yields per tree were not affected by the presence of reflective covers. Yields were raised in centrifugally pruned trees but the increase was not statistically significant. Centrifugally pruned trees in the trial plots are still recovering from initial conversion but it is anticipated by the 2019 harvest, yields from the centrifugal trees will at least equal the tall spindle trees.

Influence of bud, flower and fruitlet thinning on FDM (Work package 3)

In the third year of WP3, a repeat of bud, flower and fruitlet thinning practices carried out in 2017 was made on the same trees in 2018. The following treatments were applied:

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 Agrochemicals Ltd)

T5: Chemical Thinning - Brevis (150 SG metamitron) applied in May at BBCH 70-71 & 71-72 (funded by FAST)

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)

The results from 2018 trial mirrored those of 2017 in that no treatment significantly ($p < 0.05$) increased FDM, Application of Brevis and standard hand thinning led to a ~1% increase in FDM, measured using standard oven drying methods, but these increases were not statistically significant. Exilis and Brevis were equally effective at reducing fruit numbers, with 30.4% and 33.8% of fruit remaining on the tree respectively, when compared to ~500 fruitlets per tree counted prior to June drop. The numbers of fruit left on the tree after treating with Exilis and Brevis were similar to standard (34.3%) and late hand thinning (31.3) practices. Thinning to size removed the most fruitlets/fruits with 26.2% of the fruits remaining on the tree. Hand thinning treatments led to the highest amount of class 1 fruit (~85%). Fruits treated with Brevis and those subject to thinning to size had more advance maturity at harvest compared to un-thinned fruit. Fruits were harvested in the optimal harvest window for long-term storage which meant fruit firmness was retained throughout eight months storage in 3% CO₂, 1% O₂ (0.5-1.0°C). No evidence of internal browning at the equator or in the stem bowl was observed throughout storage.

Chlorophyll fluorescence as a means of measuring fruit maturity (Work package 4)

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. Fruits harvested with CF -prediction as early or late maturing sites were tested for Internal Ethylene Concentration (I.E.C.) using a GC-FID which confirmed the early maturing sites had higher internal ethylene concentrations than those predicted by CF to be later maturing.

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 pick 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 some 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

- 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.
- In general, implementing thinning practices did not significantly increase FDM content. However, trees that had been thinned had significantly higher sugar (fructose and sucrose) content.
- Application of Exilis or Brevis was as effective as hand-thinning in reducing overall fruit numbers recorded at harvest. However, trees treated with Exilis produced a higher number of misshapen fruits
- Thinning to size produced the highest number of fruits in the 60-70mm size category and produced trees with the largest fruit.
- The use of a chlorophyll fluorescence and subsequent data modelling provided a 7-10 advanced warning in changes in starch clearance patterns when compared to traditional starch/iodine testing used by the industry as a measure of fruit maturity and the need to start harvesting.

Financial benefits

- No direct financial benefits have arisen from this work so far.

Action points for growers

- Harvesting fruits higher in the crop canopy separately will provide consignments with higher FDM.
- In general, the practice of thinning fruits increased the sugar (fructose and sucrose) content of fruit at harvest.