

Using the Felix F-750 Produce Quality Meter



Guide for Users

Introduction

Consumer research identified that consumer satisfaction is closely aligned with sweetness of ripe mangoes measured as brix of the fruit flesh when ripe and to fruit dry matter (DM) at harvest. Once a mango is harvested, there is minimal change in its DM. The DM represents carbohydrate levels (starch and sugar) in the mango. It is an indicator of physiological and harvest maturity. The DM of a hard green mango is well correlated with the brix of a ripe fruit and brix is a determinant of eating quality.

The DM% is the dried weight of a sample of mango flesh divided by the wet weight and multiplied by 100% to bring it to a percentage. This is the % DM. Traditionally DM is calculated by physically sampling a mango and comparing the weight of the flesh when sampled to that of the dry weight, once all of the water is removed from the flesh, using an oven or dehydrator.

The development of near infrared (NIR) technology to measure dry matter means that mangoes can be assessed for dry matter while still on the tree. This non-destructive sampling technique means that many mangoes can be sampled efficiently and minimise the chance of immature fruit being harvested.

How the Felix F-750 Produce Quality Meter Works

The Felix F-750 Produce Quality Meter uses near-infrared (NIR) spectroscopy to estimate dry matter. Working like a high-powered flashlight, the F-750 sends particles of light into the mango, then measures the NIR light interactance with molecular components inside of the mango to quantify the dry matter.

This guide has been developed to assist growers and other users to understand how to use the Felix F-750 Produce Quality Meter to measure dry matter in mangoes and get the best performance from the meter.

This guide aims to minimise inaccuracies and ensure representative data is collected, so that growers have an insight into a block or consignment's average reading. Those using the meter should consider the individual mango orchard and resources (e.g. time) available when using this guide.

This guide has been developed in association Central Queensland University and Felix Instruments Inc.

Note – Each meter should be calibrated for each variety on which it is to be used. Do not attempt to use it on varieties for which it has not specifically been calibrated. Each meter should have its calibration checked prior to the season commencing.

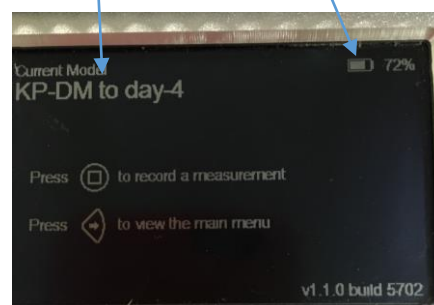
Using the Felix F-750 Produce Quality Meter

1. Setting up the machine:

- a. Turn on the machine via the small green power button located on the front of the machine (ensure this is turned on sometime before use to allow enough time for the GPS to be enabled)
- b. Ensure the battery is not lower than 15% (located in top right corner on main menu screen). If it is too low, change the battery by turning the machine off, lifting the bottom rubber cover on the machine and unscrewing the bottom left corner of the machine

Model is displayed here

Battery level is displayed here



The main menu display on the Felix F-750 Produce Quality Meter

- c. Select the correct model¹ for the fruit that you will be testing (all done with the right arrow button “->”). Ensure *measurement per specimen* is set to one (1) by pressing the right arrow button again and then press the down button once. Then press the right arrow button again on *measurements per specimen* and use the arrow buttons to select one (1). Press the left arrow button to go back to the previous menu. Ensure *scans to average* is set to four (4) by then using the down arrow button until you get to *scans to average*, then press the right arrow button and use the arrow buttons to select four (4)
- d. Ensure the current sample is set to one (1) prior to starting a new sample collection (e.g. 30 fruit for block one) and the lot number is set to one (1) (or the corresponding lot number you are on—if the block does not have a number i.e. if it has a name instead such as “Harry’s block” it would be best to start at one (1) and take a note separately of what the block is called) to do this:
 - i. Press the right arrow button from the main menu
 - ii. Press the down arrow button until you get to *setup instrument*
 - iii. Press the right arrow button once, then again on *lot and sample*
 - iv. Select *current sample #* with the right arrow button and adjust the sample number back to one (1) using the arrow buttons
 - v. Press the left arrow button to go back to the previous menu and use the down arrow button to select *current lot #*. Follow step iv again to select the lot number

¹ E.g. Kensington Pride model, R2E2 model, Calypso model, Honey Gold model

- vi.** Press the left arrow button to go back to the previous menu. Press it again to go back to the previous menu. Press the down button once to *record prefix*. Press the right arrow button once and use the arrow buttons to record a name. This is important for people who are visiting several orchards or blocks on the one day
 - vii.** Press the left arrow button until you get back to the main menu. Your machine is now ready to conduct scanning
 - viii.** Don't forget to change lot numbers if you are conducting scans on more than one block, and to change the sample number back to one (1) on each block. Don't forget to change the prefix also, each time you visit a new farm.
- 2.** When scanning the fruit, bring the scan area (at the top of the machine) to the middle of the cheek and press the small black button (that has a square in the middle) once. Be sure to hold it close to the fruit for a few seconds while the scan completes and remember to avoid blemishes, spots, sunburned fruit etc.



Be sure to hold the Felix F-750 Produce Quality Meter in the middle of the cheek

Selection of fruit for sampling

1. Ensure fruit is big enough, no smaller than the size of a small orange²
2. Consider the following regarding flowering before conducting scans as it may be better to conduct separate sample collections:
 - a. If there was a single flowering, you can conduct one sample collection (at least 30 readings) per block
 - b. If there were several flowerings in the block, or on the tree, and a strip pick is planned, readings should be taken from each flowering event^{3,4}
 - c. If planning to do a select pick on the first flowering event, it may be best to conduct a sample collection only on the first flowering event⁵
 - d. Is there any significant variations in elevation e.g. in a gully⁶ (as this will affect fruit maturity).
3. Based on the above considerations select trees that are representative of the whole orchard and select trees that are central i.e. not on the ends of the rows. If time permits it is best to mark the trees and fruit that has been tested with a ribbon and to write the date and reading on the ribbon, so that the exact same fruit can be re-tested next time and readings can be compared (if needed)
4. When conducting a sample collection, do at least 30 fruit scans per block:

² If the fruit is too small readings will be inaccurate as the infrared light that penetrates the fruit hits the seed

³ See step 3 for advice on fruit selection

⁴ All fruit should be at least the size of a small orange as specified in step 1. If not, it may be better to wait until the second flowering event has caught up to the first flowering event. You may also need to check that the flowering events are within two weeks of each other, if not there may be too much variability and separate sample collections should be taken

⁵ Once data is extracted it should be separated before sending. See an example of this in appendix one

⁶ Difference in elevation may cause different maturity in fruit to the rest of the block, therefore it would be advisable to include this section of the block in the sample collection if planning a strip pick, or conducting a separate sample collection only on this area if planning to spot pick

- a. Approximately five trees in each block should be tested
- b. Approximately two to three fruit per tree should be tested **on both sides of the fruit (four to six scans per tree)**
- c. In your sample collection ensure you are testing fruit from both the inside and outside of the tree and that you are testing fruit on both sides of the tree as well as higher and lower on the tree
- d. If there is a lot of variation in readings, it is better to get a bigger sample size dependent on the time you have.



Select fruit in the middle of the row, on both sides of the tree

Note – fruit that has already been picked can be tested with the Felix F-750 Produce Quality Meter. Sample at least 30 fruit

Obtaining the data from the machine

1. After collecting your readings turn the machine off, open the rubber lid at the top, take out the SD card and insert into your computer's SD card reader:⁷
 - a. Once the card is inserted the data viewer software should automatically upload; if not, open data viewer. Once open, select the file button in the top left corner, select open. Then select the files to open and select open again
 - b. Select the files you wish to open in the data viewer menu and then select file, export, measurements. This will create an excel spreadsheet of your measurements. Select where you would like to save the excel file and select save
 - c. Go to the location where you have saved your file and open the file. Be sure to now save the file as an **excel sheet**, rather than a CSV file, so it saves any formatting changes
 - d. You can now separate out this data by block and down the bottom of each block's readings it is suggested you create a row for the average (AVERAGE), SD (STDEV)⁸, maximum (MAX) and minimum (MIN). Ensure you change the decimal place to two places in column e, e.g. 15.20, and that data from column e (the dry matter readings) in the above rows is included in the excel formula e.g. =AVERAGE (E2:E9). Hit save once you have finished.
 - e. Before removing the SD card from the computer open the SD card on your computer and create a folder to archive your readings. Suggested format is day, month, year e.g. 1_JAN_2017. Select the files you wish to archive and drag them into this folder.
2. Once complete ensure you safely remove the SD card from the computer (eject from computer by right clicking drive and then eject, or safely remove hardware on bottom right) and then insert it back into the Felix F-750 Produce Quality Meter. Failure to remove safely may cause the data on the SD Card to be corrupted

⁷ Ensure you have first downloaded the correct data viewer software available at:
<https://felixinstruments.com/support/F-750/software/>.

Note – this software is not available for download on Mac

⁸ Standard deviation will indicate the sample size. If the standard deviation is one (1.00) and the average reading is above the minimum standard, the fruit generally should be ready to pick. If the standard deviation is more than one (1.00), it would be better to wait one to two weeks before picking the fruit to ensure the majority of the fruit tested is above the minimum standard. If your standard deviation is above two (2.00) it is suggested that another sample collection with more fruit is conducted before picking

Acceptable readings

Below are the acceptable minimum industry averages for each of the main varieties. As a rough guide, if fruit is below the average DM, it will increase in DM **by 0.7 per week (NT) / 0.6 per week (QLD)**.

Please note that this is only a guide, and further sampling should be undertaken before you commence harvest

Variety	Dry Matter % DM
Kensington Pride, Calypso, Honey Gold	15%
R2E2	13%

Appendix one – example of readings in an excel spreadsheet

Filename	Created Date & Time	Model	Prediction 1 Name	Prediction 1 Value
R2E2 BLOCK ONE				
EXAMPLE_1_1.f750dat	12/14/2016 10:51:51 AM	AMAR2E2-2016-11-16	Reference Value #1	15.88
EXAMPLE_1_2.f750dat	12/14/2016 10:52:01 AM	AMAR2E2-2016-11-16	Reference Value #1	15.91
EXAMPLE_1_3.f750dat	12/14/2016 10:53:04 AM	AMAR2E2-2016-11-16	Reference Value #1	17.04
EXAMPLE_1_4.f750dat	12/14/2016 10:53:14 AM	AMAR2E2-2016-11-16	Reference Value #1	16.25
EXAMPLE_1_5.f750dat	12/14/2016 10:53:32 AM	AMAR2E2-2016-11-16	Reference Value #1	14.53
EXAMPLE_1_6.f750dat	12/14/2016 10:53:42 AM	AMAR2E2-2016-11-16	Reference Value #1	16.44
EXAMPLE_1_7.f750dat	12/14/2016 10:54:50 AM	AMAR2E2-2016-11-16	Reference Value #1	15.97
EXAMPLE_1_8.f750dat	12/14/2016 10:55:01 AM	AMAR2E2-2016-11-16	Reference Value #1	15.00
EXAMPLE_1_9.f750dat	12/14/2016 10:55:15 AM	AMAR2E2-2016-11-16	Reference Value #1	14.34
EXAMPLE_1_10.f750dat	12/14/2016 10:55:25 AM	AMAR2E2-2016-11-16	Reference Value #1	14.00
EXAMPLE_1_11.f750dat	12/14/2016 10:55:45 AM	AMAR2E2-2016-11-16	Reference Value #1	15.42
EXAMPLE_1_12.f750dat	12/14/2016 10:55:55 AM	AMAR2E2-2016-11-16	Reference Value #1	14.70
EXAMPLE_1_13.f750dat	12/14/2016 10:56:14 AM	AMAR2E2-2016-11-16	Reference Value #1	16.28
EXAMPLE_1_14.f750dat	12/14/2016 10:56:24 AM	AMAR2E2-2016-11-16	Reference Value #1	16.39
EXAMPLE_1_15.f750dat	12/14/2016 10:57:26 AM	AMAR2E2-2016-11-16	Reference Value #1	13.27
EXAMPLE_1_16.f750dat	12/14/2016 10:57:38 AM	AMAR2E2-2016-11-16	Reference Value #1	14.95
EXAMPLE_1_17.f750dat	12/14/2016 10:58:11 AM	AMAR2E2-2016-11-16	Reference Value #1	15.51
EXAMPLE_1_18.f750dat	12/14/2016 10:58:21 AM	AMAR2E2-2016-11-16	Reference Value #1	15.82
EXAMPLE_1_19.f750dat	12/14/2016 10:58:37 AM	AMAR2E2-2016-11-16	Reference Value #1	14.93
EXAMPLE_1_20.f750dat	12/14/2016 10:58:47 AM	AMAR2E2-2016-11-16	Reference Value #1	14.80
EXAMPLE_1_21.f750dat	12/14/2016 10:59:20 AM	AMAR2E2-2016-11-16	Reference Value #1	15.09
EXAMPLE_1_22.f750dat	12/14/2016 10:59:30 AM	AMAR2E2-2016-11-16	Reference Value #1	14.10
EXAMPLE_1_23.f750dat	12/14/2016 11:00:03 AM	AMAR2E2-2016-11-16	Reference Value #1	14.35
EXAMPLE_1_24.f750dat	12/14/2016 11:00:13 AM	AMAR2E2-2016-11-16	Reference Value #1	15.12
EXAMPLE_1_25.f750dat	12/14/2016 11:00:33 AM	AMAR2E2-2016-11-16	Reference Value #1	13.76
EXAMPLE_1_26.f750dat	12/14/2016 11:00:44 AM	AMAR2E2-2016-11-16	Reference Value #1	15.50
EXAMPLE_1_27.f750dat	12/14/2016 11:01:04 AM	AMAR2E2-2016-11-16	Reference Value #1	14.35
EXAMPLE_1_28.f750dat	12/14/2016 11:01:15 AM	AMAR2E2-2016-11-16	Reference Value #1	15.71
EXAMPLE_1_29.f750dat	12/14/2016 11:01:28 AM	AMAR2E2-2016-11-16	Reference Value #1	14.36
EXAMPLE_1_30.f750dat	12/14/2016 11:01:38 AM	AMAR2E2-2016-11-16	Reference Value #1	15.49
MAXIMUM				17.04
MINIMUM				13.27
AVERAGE				15.18
STDEV				0.90