



Introducing the Malusim app

Poliana Francescatto &
Jaume Lordan, Cornell University
Jon Clements, UMass Amherst



Malusim app interface showing measurement entry for five trees.

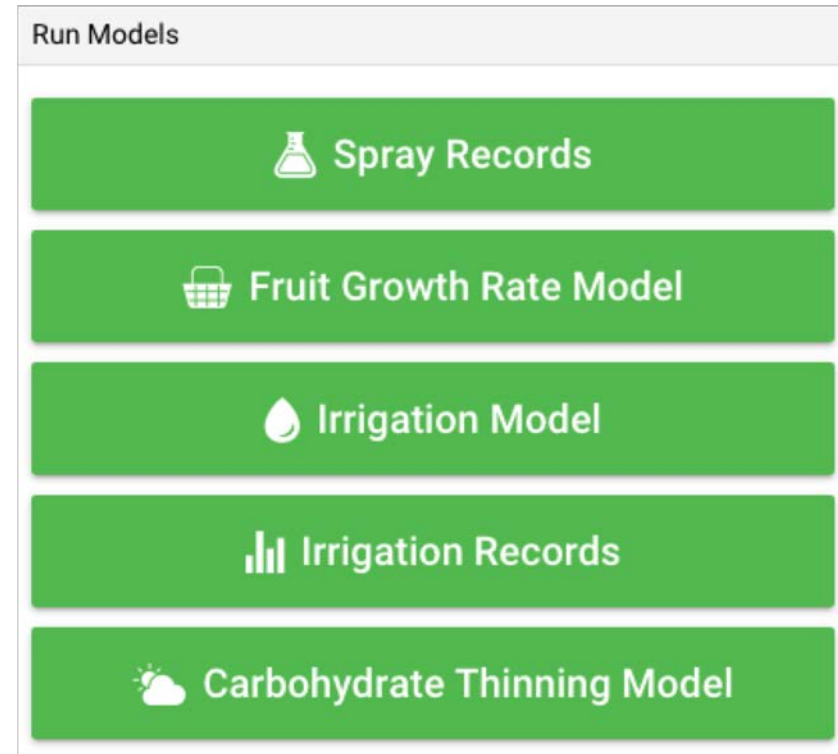
Enter Measurements (Help)

Tree 1 | Tree 2 | Tree 3 | Tree 4 | Tree 5

Cluster	Fruitlet #1	Fruitlet #2
Cluster 1 (5)		
Cluster 2 (5)	7.3	6.5
Cluster 3 (5)		
Cluster 4 (5)		
Cluster 5 (5)		

Introducing the Malusim app

- Fruit growth rate model
- Carbohydrate thinning model
- Malusim on web, iPhone (Apple iOS), and Android (Google Play)
- Irrigation model/records
- Live demo



Fruit growth rate model

- Assumes faster growing fruitlets will persist, slower growing fruitlets will fall off
- Two or more consecutive measurements of fruitlets to quantify growth rate
- Measurements start at app. 6 to 7 mm. fruitlet diameter, then every 4 to 7 days depending on temperature and chemical thinner applications, determines growth rate
- Average growth rate calculated: if fruit is above average growth rate it will persist; if below will fall off
- Based on number of flowers, a target crop load (number of fruit) and % fruit set determined
- At time of measurement, can determine if another chemical thinner application needs to be made...



Table 1. Fruitset prediction hypothesis.

Fruitlet Fate	Prediction
Persist	A fruit is predicted to persist if the growth rate over the measurement period was at least 50% or greater of the fastest growing fruit.
Abscise	A fruit is predicted to abscise if the growth rate of the fruit slowed to 50% or less of the growth rate of the fastest growing fruit.

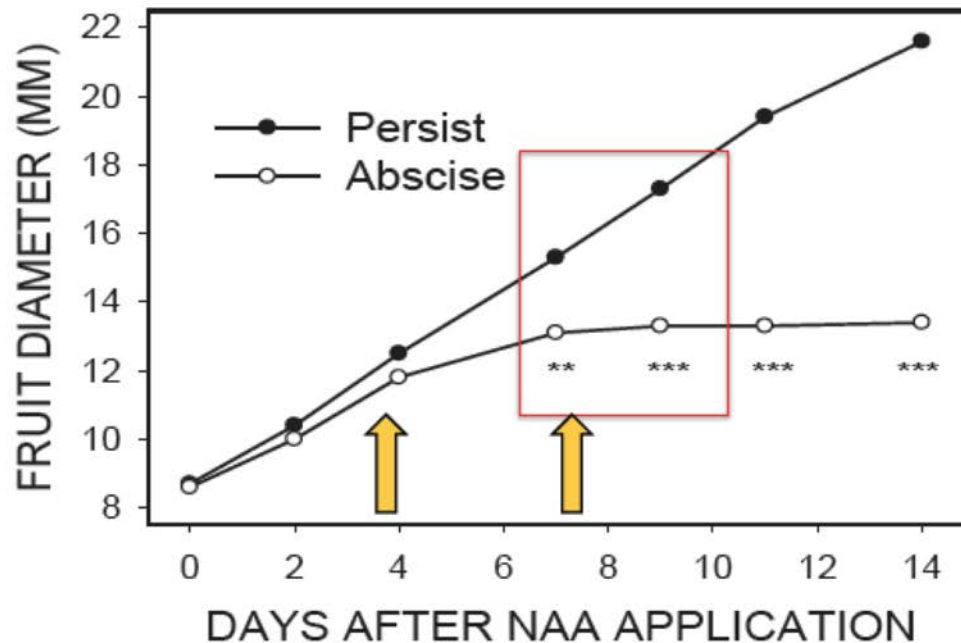


Table 4. Predicting Percent Fruitset Summary Sheet Example.

Summary Sheet									
Farm: TestData Farm Block: Test Block									
Target Fruit Number					Target % Fruitset				
35					7%				
Sampling			Diameter (mm)		Diameter Growth (mm)		Number of Fruit		Predicted % Setting
Number	Date	Days between sample dates	Mean of 20 largest fruitlets	Mean of all fruitlets	Mean of up to 20 fastest growing fruitlets	50% fastest growing fruitlets	>50% fastest	<50% fastest	Measured
1	5/1	0	10.05	7.04					505
2	5/4	3	13.21	7.55	3.54	1.77	64	419	483
3	5/7	3	15.98	8.27	3.32	1.66	50	368	418
4	5/10	3	17.56	8.89	1.88	0.94	43	329	372
5	5/13	3	19.88	10.60	2.72	1.36	38	173	211
6	5/16	3	21.31	12.13	1.68	0.84	41	112	153
7	5/19	3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0

Predicted % Setting

Sample	Based on Original # of Fruit (%)	Target % Fruitset (%)
2	13	7
3	10	7
4	9	7
5	8	7
6	8	7
7	0	7

Predicted Number of Fruit Setting

Sample	>50% fastest	Target Fruit Number
2	64	35
3	50	35
4	43	35
5	38	35
6	41	35
7	0	35

Predicted number of fast growing fruit

Target number of fruit and target percent.

Number of fruit originally marked and measured.

Predicted % fruitset of the original measured fruitlets.

Predicted % fruitset of the original measured fruitlets (blue bar).

Predicted number of fruit setting (blue bar).

Target number of fruit (green bar).

Carbohydrate thinning model

- Apple trees produce (photosynthesis) or use (respiration) carbohydrates beginning at green tip
- Carbohydrate production or use depends mostly on sunlight and temperature
- More sunlight = more carbohydrate produced
- Higher temperature (particularly at night) = more carbohydrate used
- Can calculate a daily balance per a fairly complicated model/simulation developed by Cornell scientist Lakso et al
- Cumulative daily balance can determine trees carbohydrate balance, and thus degree to which it may be *easy* or *hard* to thin with chemical thinner = carbohydrate thinning model



Weather Data Quick Links

Past 12 months shown. Current month highlighted.

Daily Summary

Apr May Jun Jul Aug Sep
Oct Nov Dec Jan Feb Mar

Hourly Data

Apr May Jun Jul Aug Sep
Oct Nov Dec Jan Feb Mar

Growing Degree Days (Base 50F)

Apr May Jun Jul Aug Sep
Oct Nov Dec Jan Feb Mar

Growing Degree Days (Base 50F BE)

Apr May Jun Jul Aug Sep
Oct Nov Dec Jan Feb Mar

Growing Degree Days (Base 86/50F)

Apr May Jun Jul Aug Sep
Oct Nov Dec Jan Feb Mar

National Weather Service Forecast

Belchertown

These Station biofix dates for more accurate results, use locations.

Apple Carbohydrate Thinning
Apple Irrigation
Apple Evapotranspiration
Apple Frost Risk
Growing Degree Days
Degree Day Calculator
Turf Evapotranspiration Map
Soil Temperature Map
Other Crop Tools
Apple Pollen Tube Growth

Station Page

most accurate when you use your own results displayed will use NEWA's default on the forecast page, where prompted, ns. After getting the Station Page forecast to get query results for prior years, dates, and

Belchertown-2 Pest Forecasts

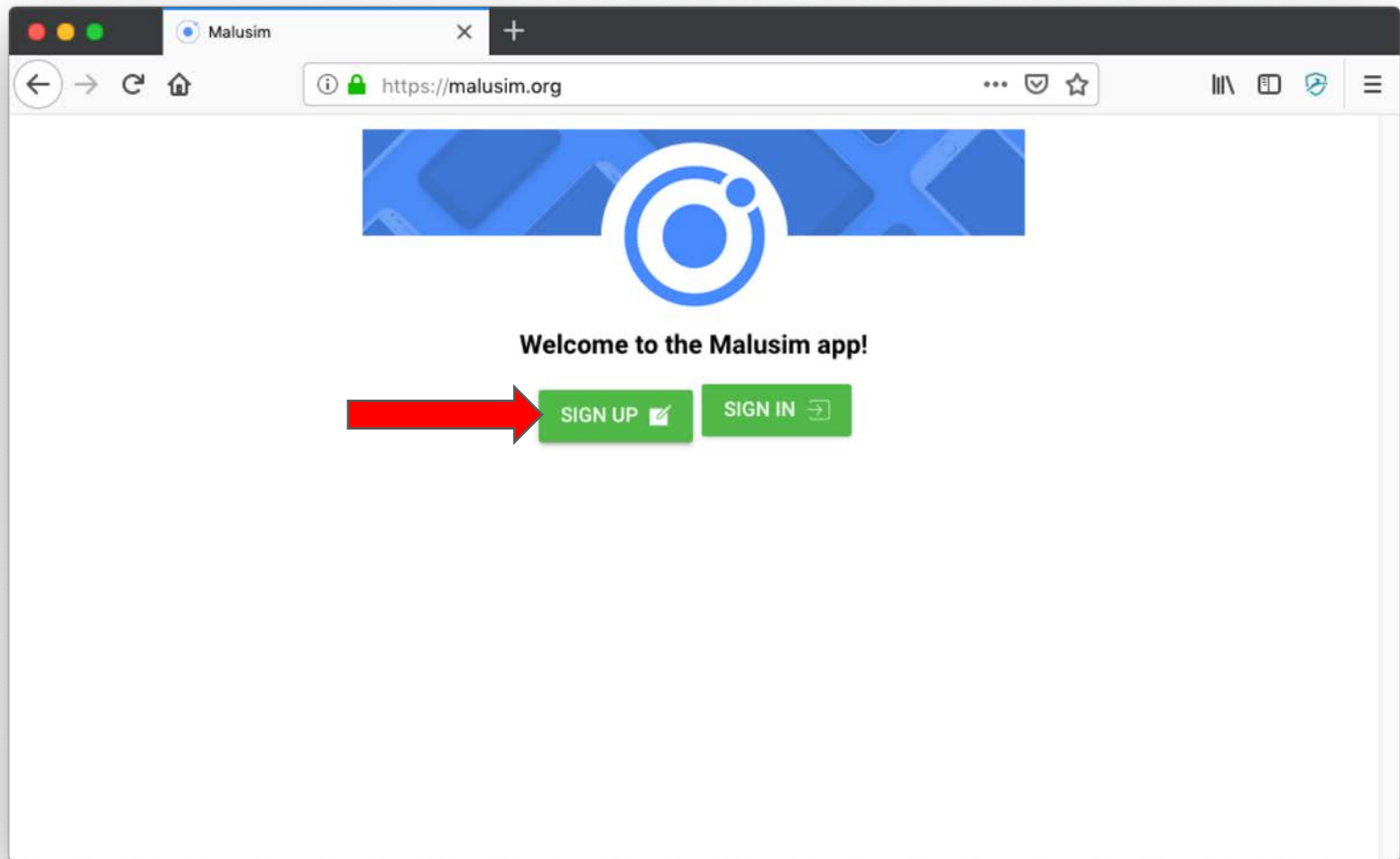
Apple Scab Plum Curculio Grape Berry Moth
Fire Blight Obliquebanded Leafroller Cabbage Maggot
Sooty Blotch/Flyspeck Apple Maggot Onion Maggot
Leaf Wetness Events San Jose Scale Onion Diseases
Spotted Tentiform Leafminer Grape Diseases Potato Diseases
Oriental Fruit Moth Grapevine Downy Mildew Tomato Diseases
Codling Moth

5/13	63	44	21.9	30.76	30.92	-0.16	-23.03	Decrease chemical thinner rate by 15%
5/14	74	49	20.7	31.08	49.37	-18.29	-32.31	Decrease chemical thinner rate by 15%
5/15	82	55	12.6	17.44	72.04	-54.60	-25.43	Decrease chemical thinner rate by 15%
5/16	63	50	13.5	28.78	47.87	-19.09	-15.29	Apply standard chemical thinner rate
5/17	74	55	15.0	32.71	69.95	-37.25	-14.98	Apply standard chemical thinner rate
5/18	66	46	23.0	59.12	49.93	9.20	-4.69	Apply standard chemical thinner rate
5/19	57	44	7.2	23.25	37.26	-14.01		
5/20	73	58	23.1	63.69	81.54	-17.85		
5/21	77	50	25.6	78.38	74.47	3.91		

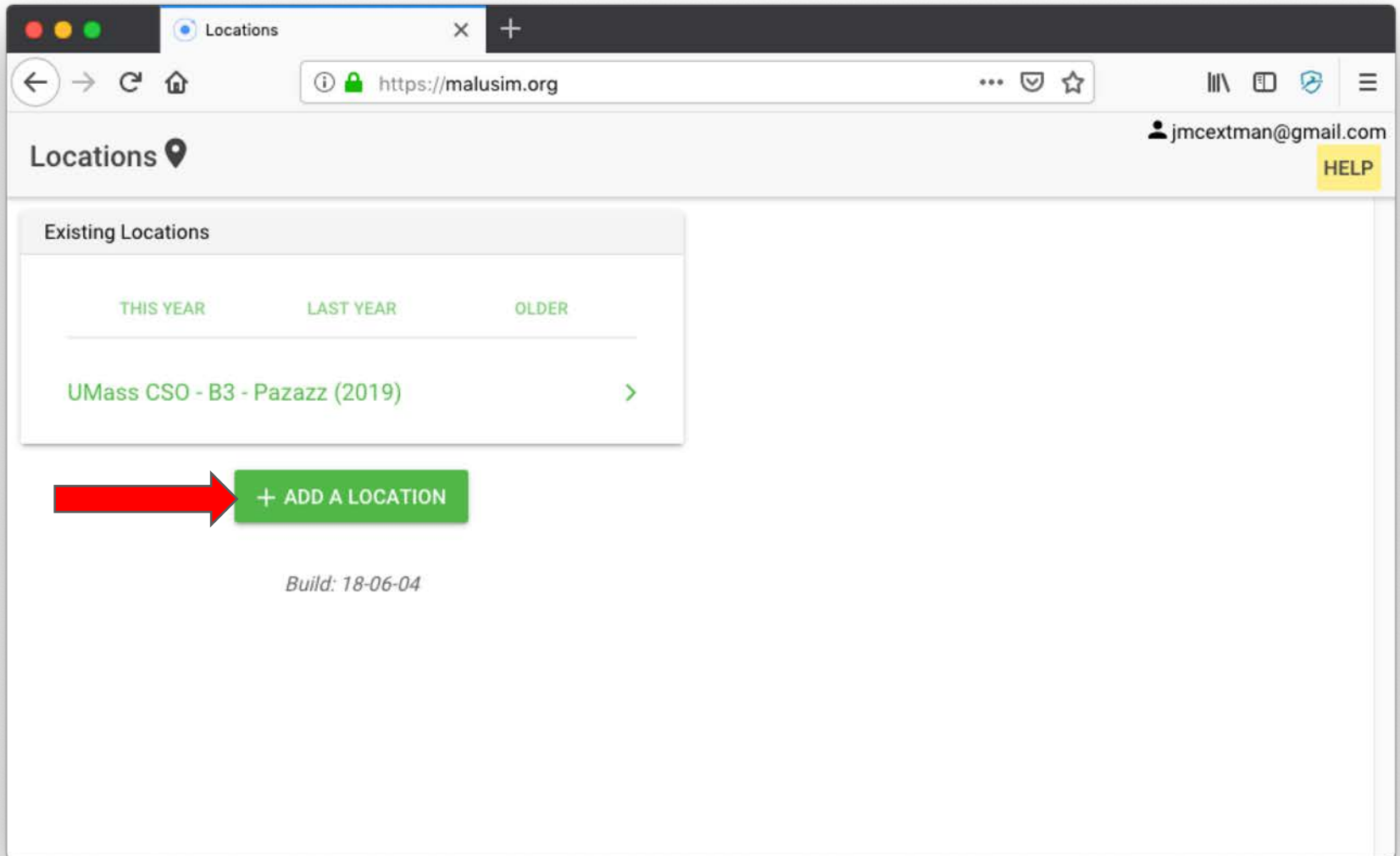
Carbohydrate Balance



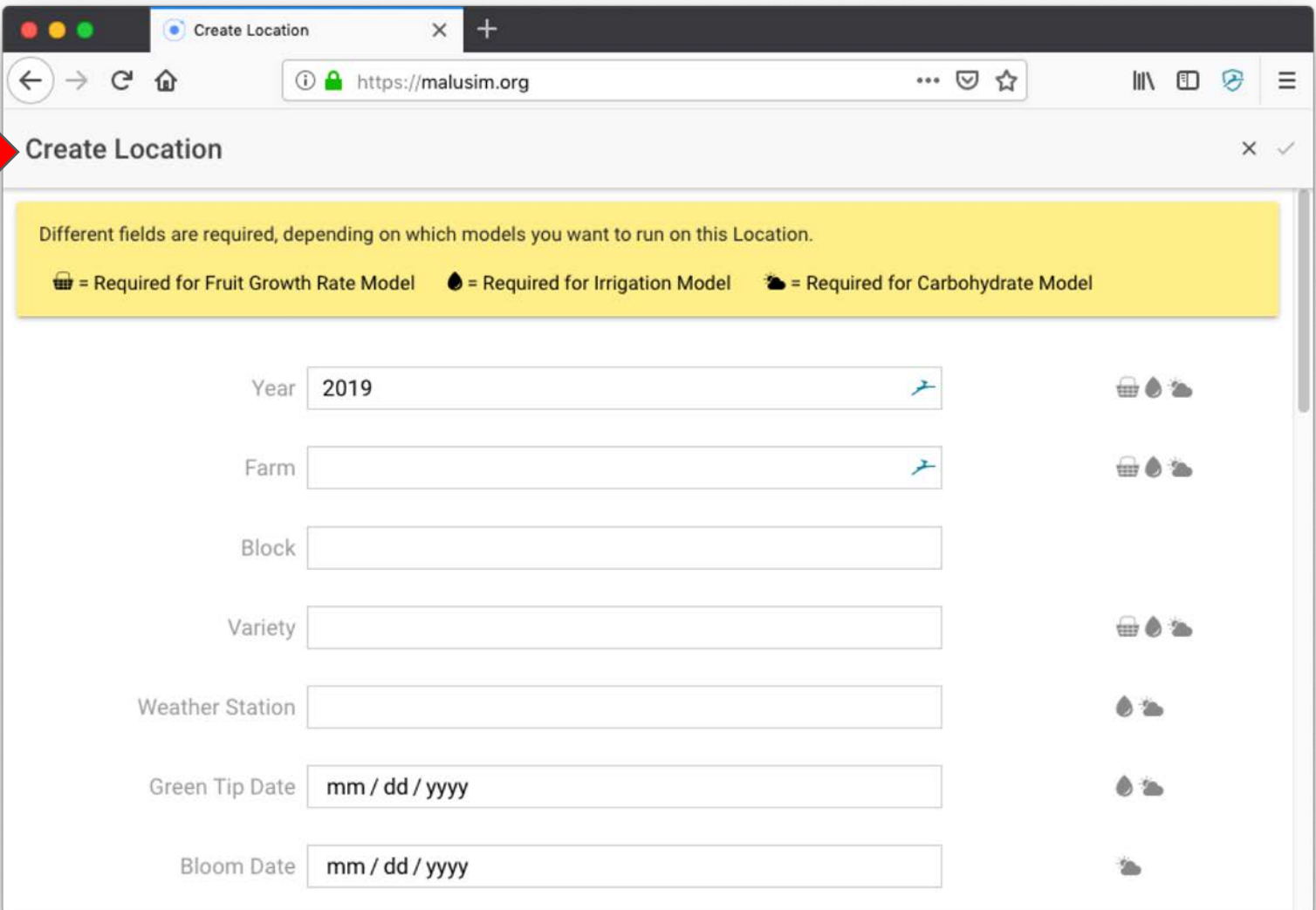
https://malusim.org - SIGN UP, SIGN IN...



Malusim.org -- ADD A LOCATION












Malusim.org -- Create Location



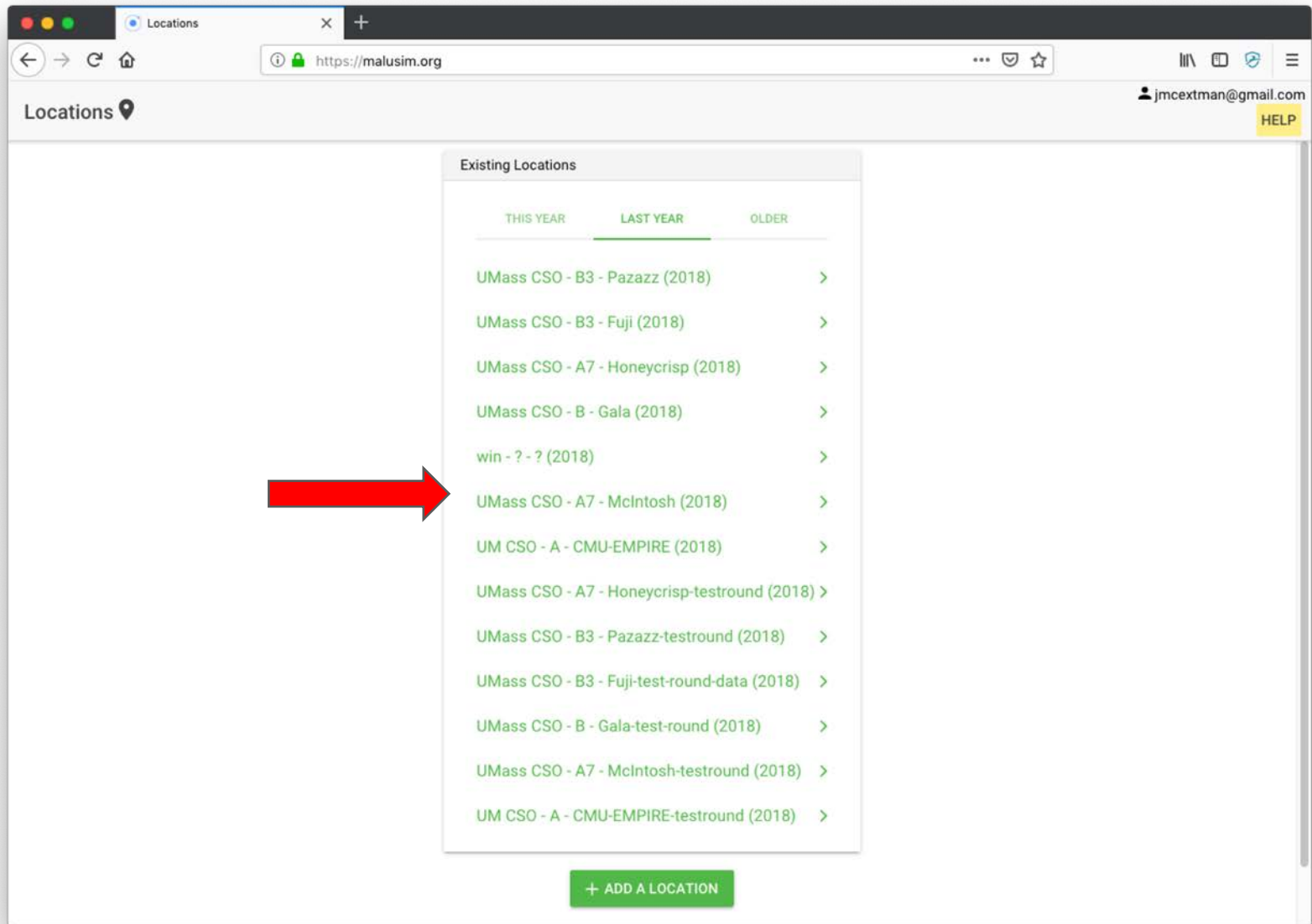
Create Location

Different fields are required, depending on which models you want to run on this Location.

 = Required for Fruit Growth Rate Model  = Required for Irrigation Model  = Required for Carbohydrate Model

Year	<input type="text" value="2019"/>	
Farm	<input type="text"/>	
Block	<input type="text"/>	
Variety	<input type="text"/>	
Weather Station	<input type="text"/>	
Green Tip Date	<input type="text" value="mm / dd / yyyy"/>	
Bloom Date	<input type="text" value="mm / dd / yyyy"/>	

Malusim.org -- Locations



The screenshot shows a web browser window with the URL <https://malusim.org>. The page title is "Locations" with a location pin icon. The user is logged in as jmcextman@gmail.com. A yellow "HELP" button is in the top right corner.

The main content area is titled "Existing Locations" and contains a table with three columns: "THIS YEAR", "LAST YEAR", and "OLDER". The "LAST YEAR" column is currently selected and highlighted with a green underline. A red arrow points to the "LAST YEAR" column header.

THIS YEAR	LAST YEAR	OLDER
	UMass CSO - B3 - Pazazz (2018)	>
	UMass CSO - B3 - Fuji (2018)	>
	UMass CSO - A7 - Honeycrisp (2018)	>
	UMass CSO - B - Gala (2018)	>
	win - ? - ? (2018)	>
	UMass CSO - A7 - McIntosh (2018)	>
	UM CSO - A - CMU-EMPIRE (2018)	>
	UMass CSO - A7 - Honeycrisp-testround (2018)	>
	UMass CSO - B3 - Pazazz-testround (2018)	>
	UMass CSO - B3 - Fuji-test-round-data (2018)	>
	UMass CSO - B - Gala-test-round (2018)	>
	UMass CSO - A7 - McIntosh-testround (2018)	>
	UM CSO - A - CMU-EMPIRE-testround (2018)	>

At the bottom of the page, there is a green button labeled "+ ADD A LOCATION".

Malusim.org -- Location Details

The screenshot shows the Malusim.org website interface. The browser address bar displays <https://malusim.org>. The page title is "Location Details".

Run Models

- Spray Records
- Fruit Growth Rate Model** (highlighted with a red arrow)
- Irrigation Model
- Irrigation Records
- Carbohydrate Thinning Model

Location

UMass CSO - A7 - Honeycrisp (2018)

Details

Year	2018
Farm	UMass CSO
Block	A7
Variety	Honeycrisp
Weather Station	Belchertown-2
Green Tip Date	Apr 10, 2018
Bloom Date	May 10, 2018
Orchard Age	mature
In Row Spacing	3 ft
Between Row Spacing	14 ft
Trees Per Acre	1037
Tree Width	ft
Tree Height	ft
Tree Row Volume	
Emitter In Row Spacing	3 ft

Malusim.org -- Edit Fruit Growth Rate Dataset

The screenshot displays the 'Edit Fruit Growth Rate Dataset' modal window on the Malusim.org website. The modal is titled 'Edit Fruit Growth Rate Dataset' and contains a list of parameters for five trees. A red arrow points to the 'Tree #2' row, which has a value of 90. The background shows the 'Fruit Growth Rate Model' interface, which includes a bar chart and a 'Potential: 100% (450 fruit)' label.

Edit Fruit Growth Rate Dataset	
# of Trees	5
# of Clusters per Tree	5
# of Fruitlets per Cluster	5
Flower Clusters Counted per Tree	
Tree #1	110
Tree #2	90
Tree #3	80
Tree #4	80
Tree #5	90
Avg. Flower Clusters Counted per Tree	90
Potential Fruit per Tree	450
Target Fruit per Tree	50

Background Interface Details:

- Location: UMass CSO - A7 - Honeycrisp (2018)
- Target Fruit per Tree: 50
- Potential: 100% (450 fruit)
- Percentage/Number of Fruit: 100% (450), 75% (338), 50% (225), 25% (113)
- Target: 11% (50 fruit per tree)
- Bar Chart Data: 135 fruit, 117 fruit, 90 fruit

Malusim.org -- Enter Measurements

The screenshot shows the 'Enter Measurements' page on the Malusim.org website. The browser's address bar shows 'https://malusim.org'. The page has a sidebar on the left with tabs for 'Tree 1', 'Tree 2', 'Tree 3', 'Tree 4', and 'Tree 5'. Under 'Tree 1', there are five clusters: 'Cluster 1 (5)', 'Cluster 2 (4)', 'Cluster 3 (5)', 'Cluster 4 (5)', and 'Cluster 5 (4)'. The main content area displays five 'Fruitlet' entries, each with a numerical value in a text input field. The values are: Fruitlet #1 (9.1), Fruitlet #2 (6.3), Fruitlet #3 (6.5), Fruitlet #4 (6.8), and Fruitlet #5 (6.3). A red arrow points to the input field for Fruitlet #3. At the bottom of the main area is a green button labeled 'Clear Measurements' with a close icon. The URL bar at the bottom shows 'https://malusim.org/#'.

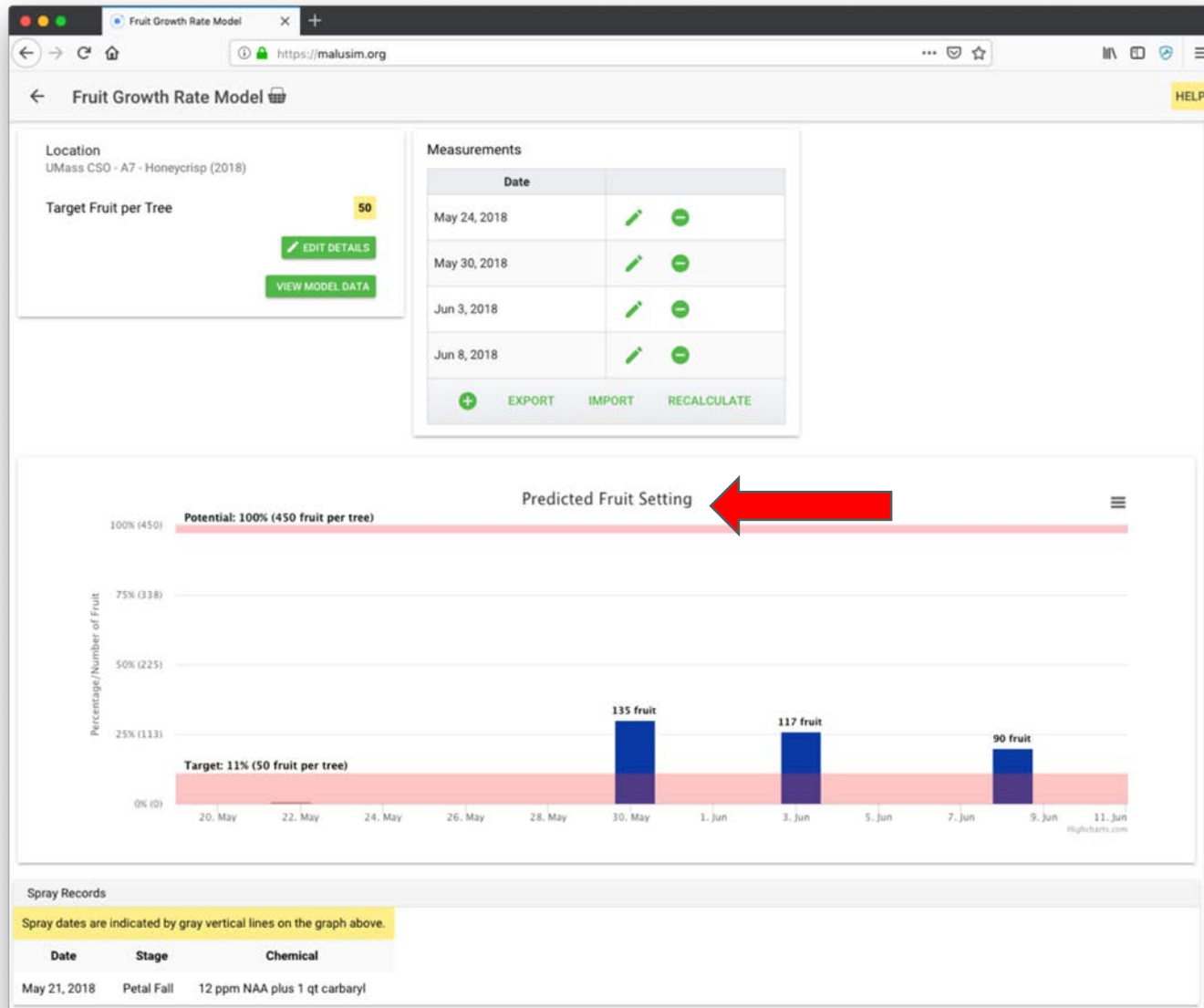
Fruitlet	Value
Fruitlet #1	9.1
Fruitlet #2	6.3
Fruitlet #3	6.5
Fruitlet #4	6.8
Fruitlet #5	6.3

Clear Measurements

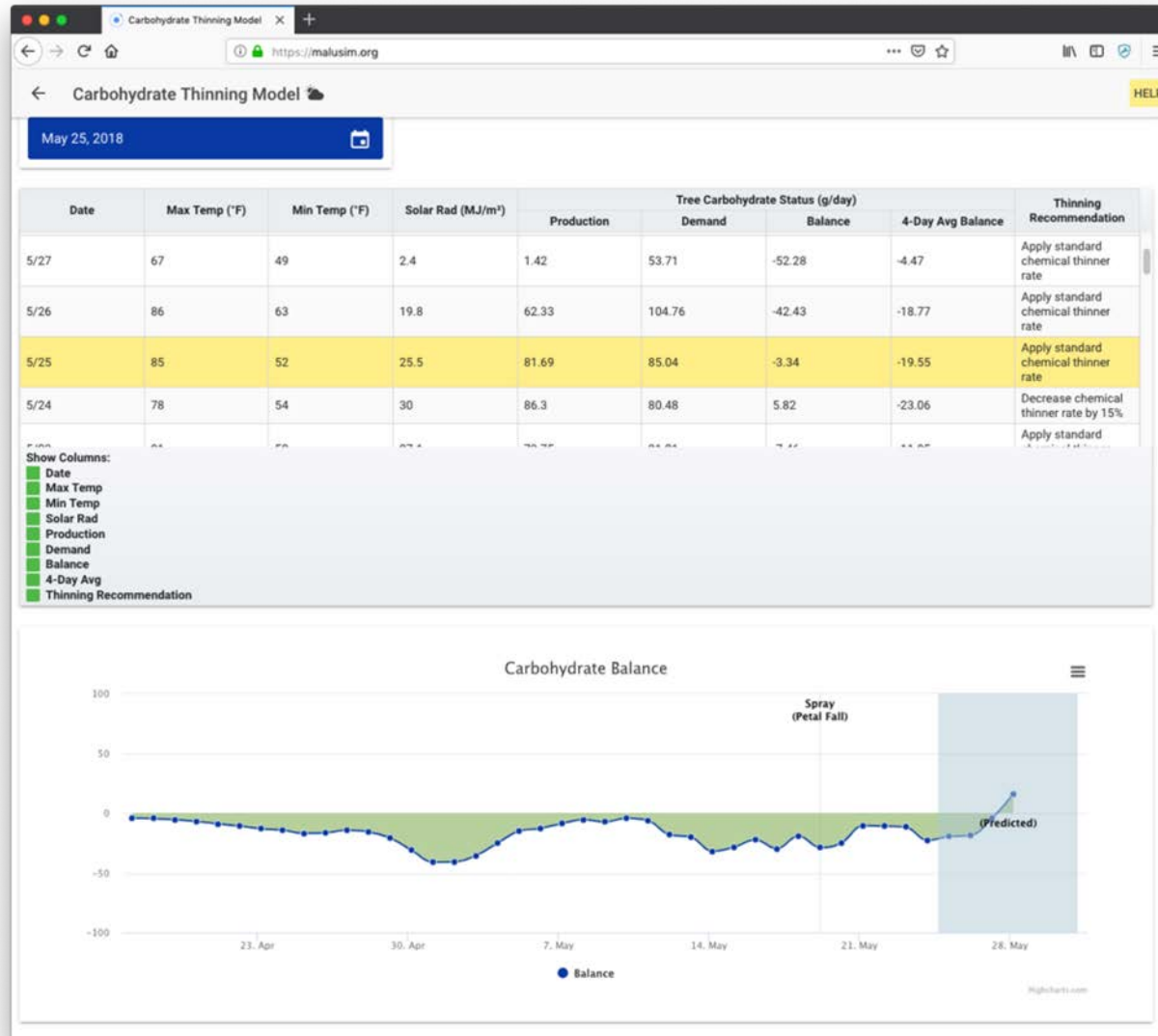
Measurements can be entered:

- Manually
- Voice input
- Imported (and exported)

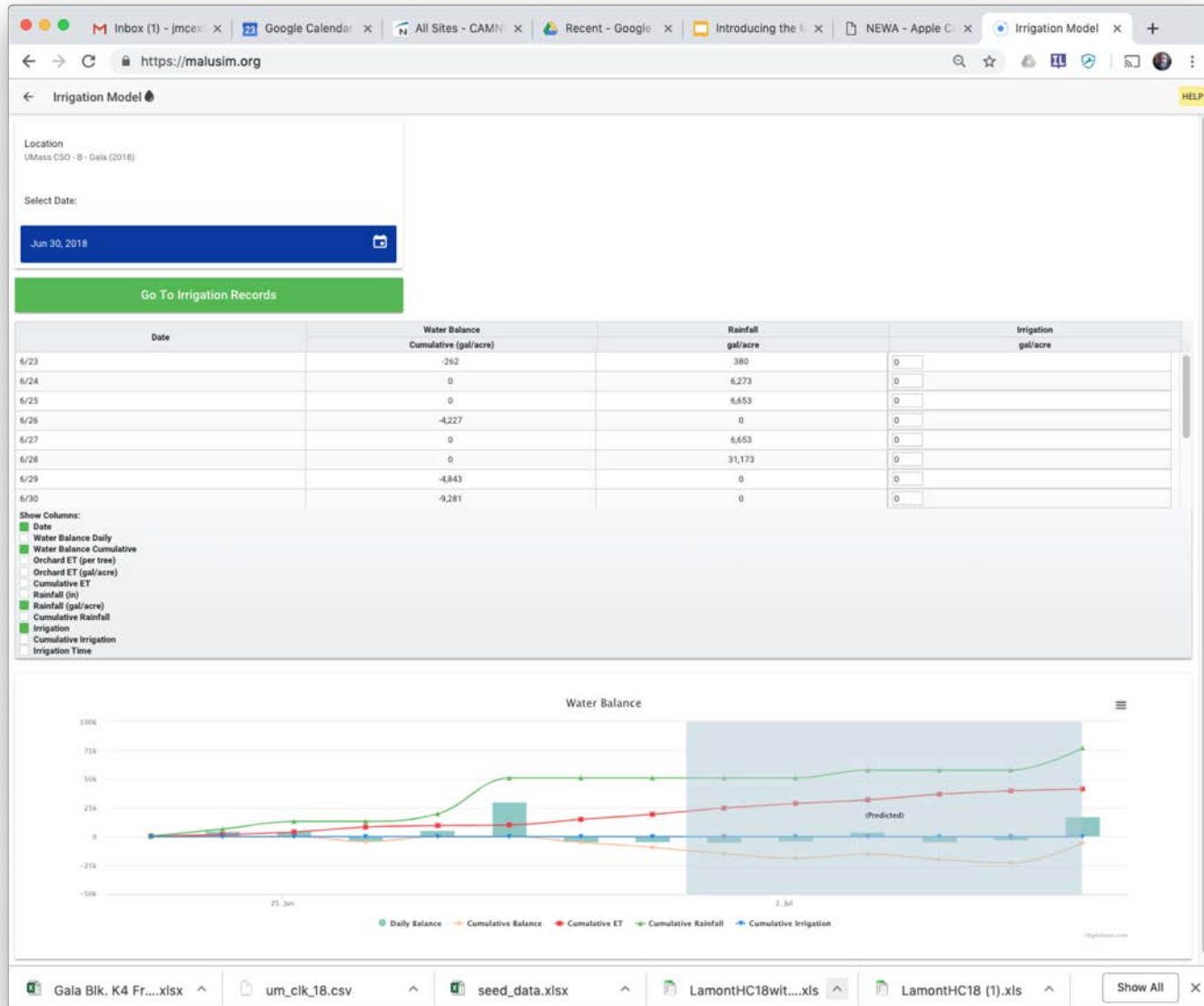
Malusim.org – Predicted Fruit Setting



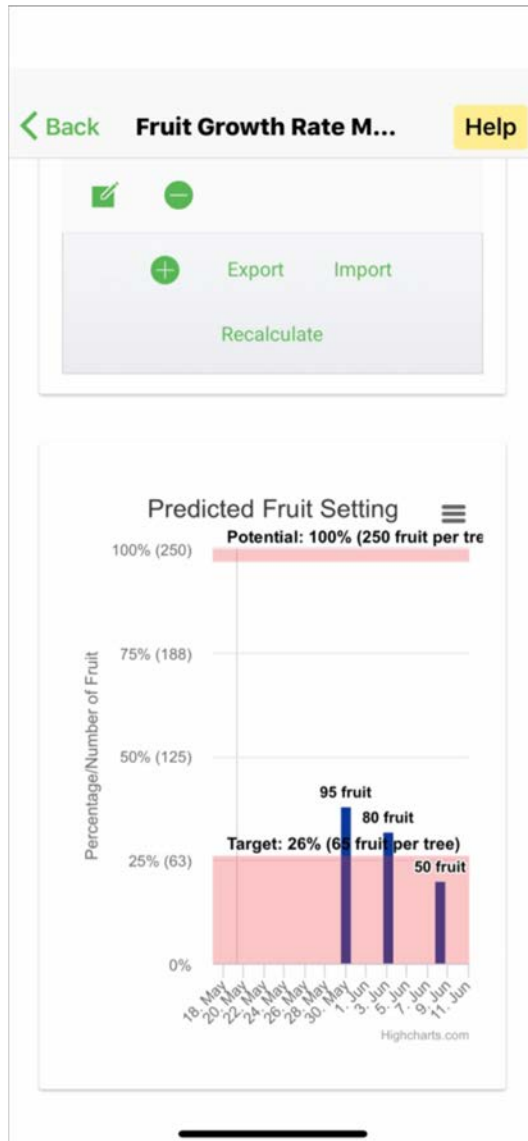
Malusim.org -- Carbohydrate Thinning Model



Malusim -- Irrigation model



Malusim – on iPhone and Android



Malusim app interface (Android) showing the "Enter Measurements" screen. The screen includes a "Back" button, a "HELP" button, and a "Clear Measurements" button. The screen displays a list of trees (Tree 1 to Tree 5) and a list of clusters (Cluster 1 to Cluster 5). Each cluster has a "Fruitlet" number and a measurement value.

The screen displays a list of trees (Tree 1 to Tree 5) and a list of clusters (Cluster 1 to Cluster 5). Each cluster has a "Fruitlet" number and a measurement value.

Tree	Cluster	Fruitlet	Measurement
Tree 1	Cluster 1 (5)	Fruitlet #1	6.8
	Cluster 2 (5)	Fruitlet #2	5.7
	Cluster 3 (5)	Fruitlet #3	5.4
	Cluster 4 (5)	Fruitlet #4	5.1
	Cluster 5 (5)	Fruitlet #5	5.3

Thanks to NY *farm viability* Institute...

“Improving Apple Grower Profitability
Through Precision Management by
Developing and Implementing a Smart App”
(Jaume Lordan Sanahuja)

