Rutgers

School of Environmental & Biological Sciences

Heat Protection

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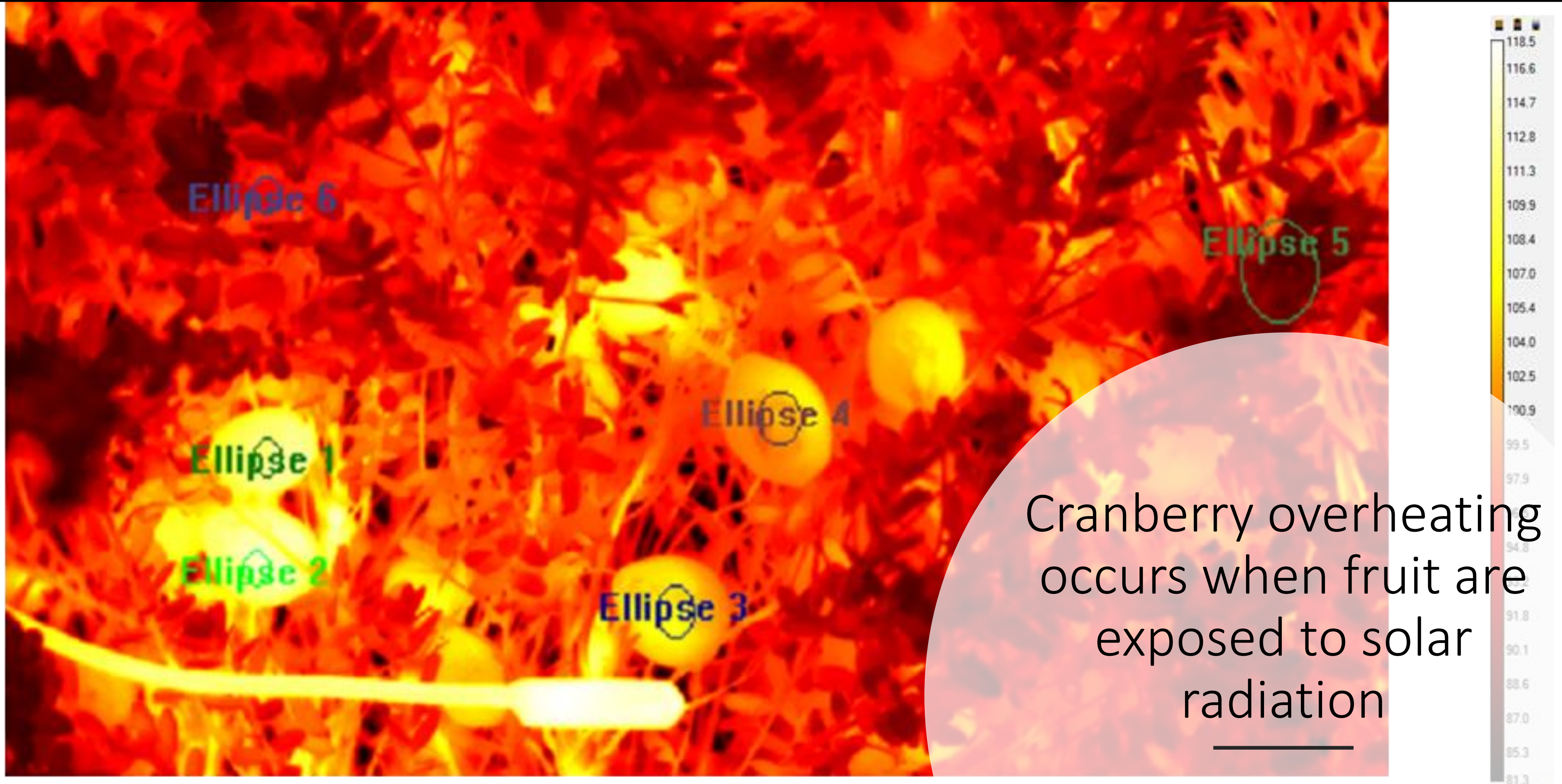
Philip E. Marucci
Blueberry and Cranberry
Research and Extension Center

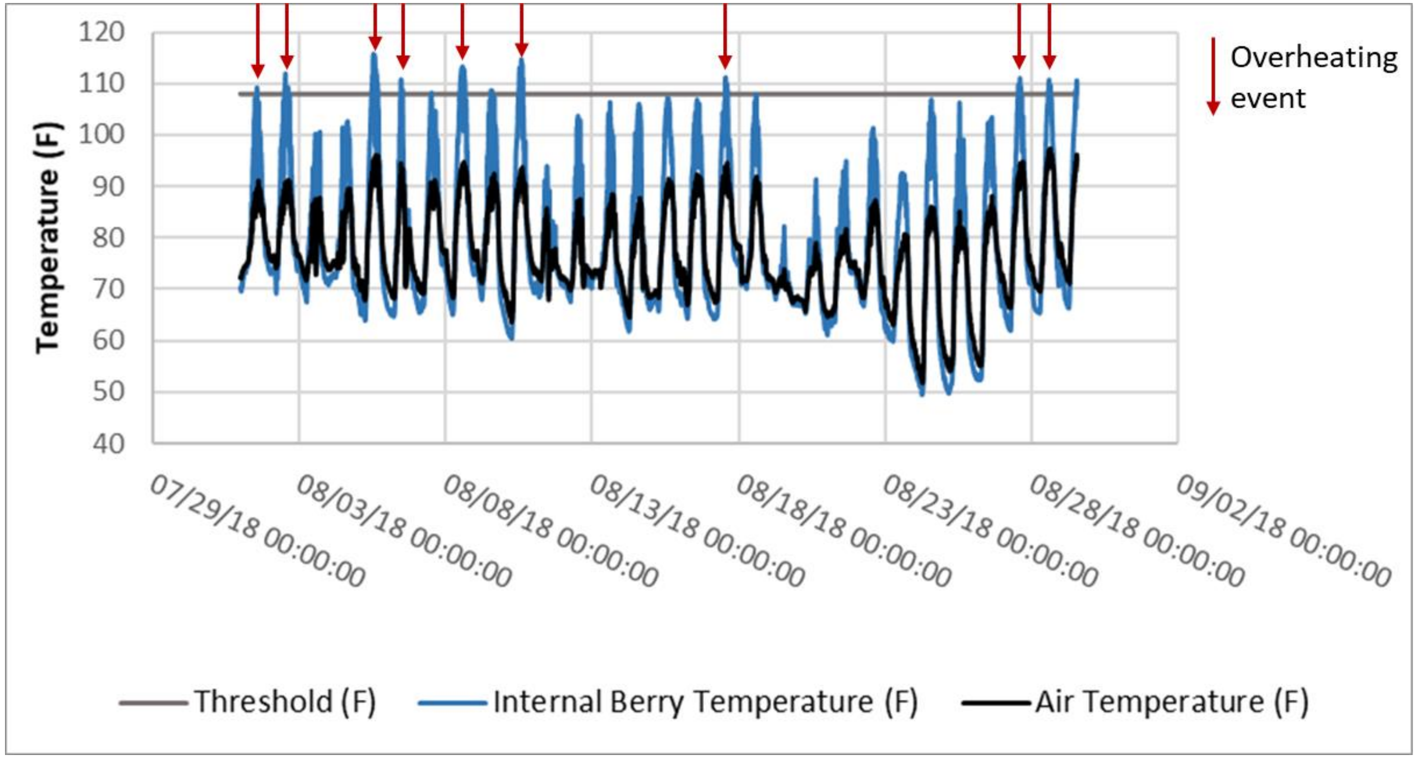
RUTGERS
New Jersey Agricultural
Experiment Station

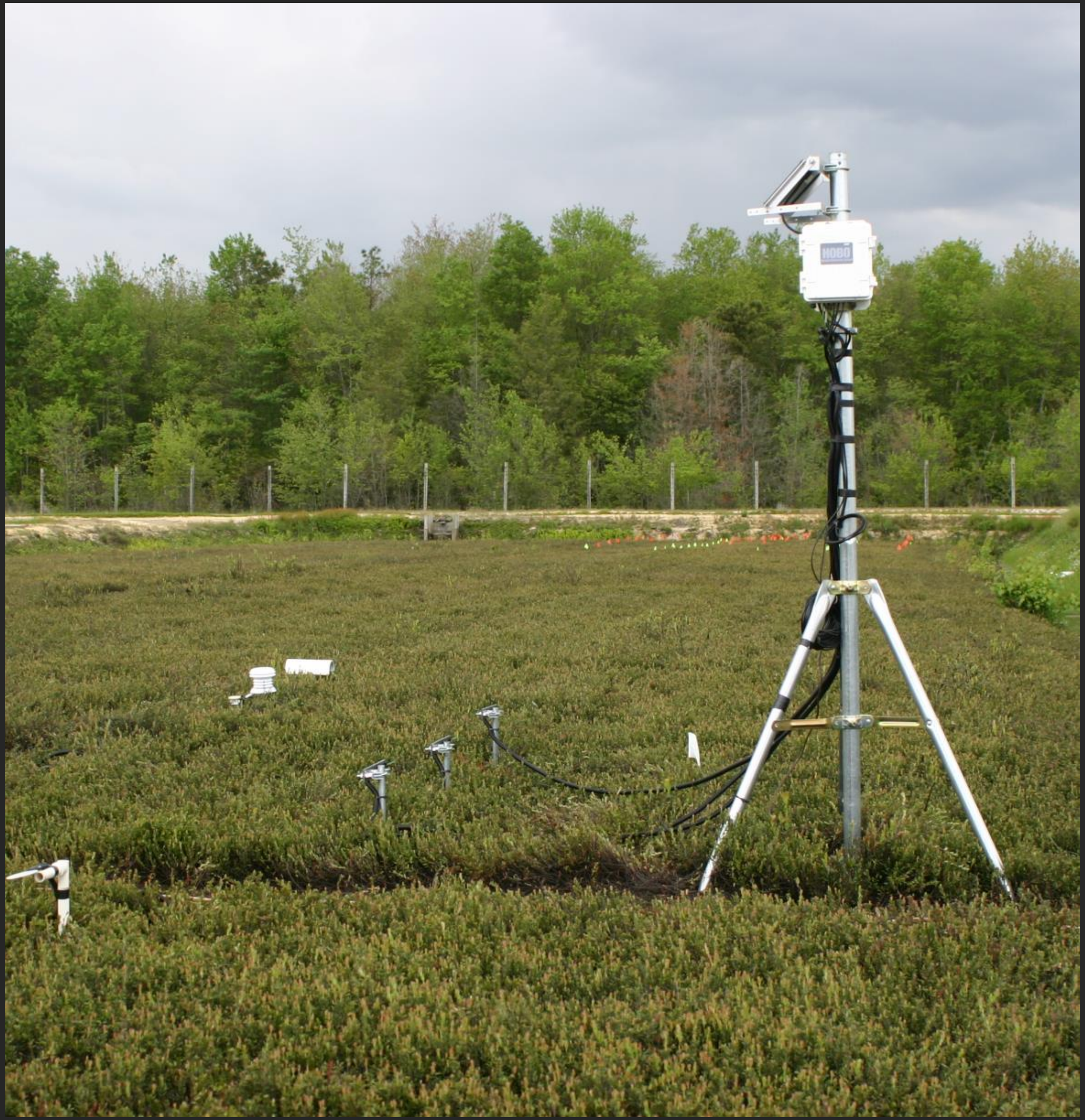


Cranberry overheating occurs when fruit are exposed to solar radiation

Statistic [units]	Ellipse 1	Ellipse 2	Ellipse 3	Ellipse 4	Ellipse 5	Ellipse 6
Mean [°F]	111.3	113.9	105.4	102.0	89.0	94
Std. Dev. [°F]	0.7	0.9	1.0	1.0	2.5	0
Center [°F]	(128.0, 253.0) 110.9	(124.0, 293.5) 114.3	(283.0, 309.5) 106.4	(322.5, 238.5) 102.9	(512.5, 184.5) 87.7	(127.5, 156.5) 94
Maximum [°F]	(132, 255) 112.3	(127, 292) 115.2	(280, 316) 107.2	(325, 230) 104.6	(511, 167) 100.5	(127, 151) 96
Minimum [°F]	(124, 252) 110.0	(120, 296) 111.7	(289, 313) 103.4	(317, 244) 99.3	(512, 179) 86.7	(126, 159) 93

Identifying Overheating Events




HOBO



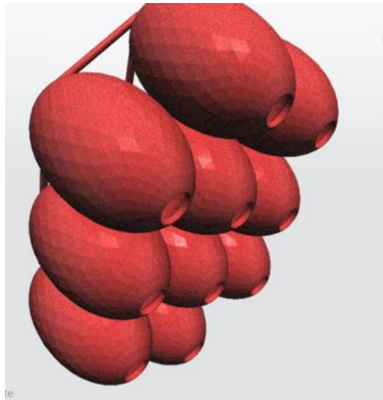
WatchDog 1650 Micro Station - w/4 External Ports
3688WD1 $475.00

LightScout Silicon Pyranometer
3670I
$269.00

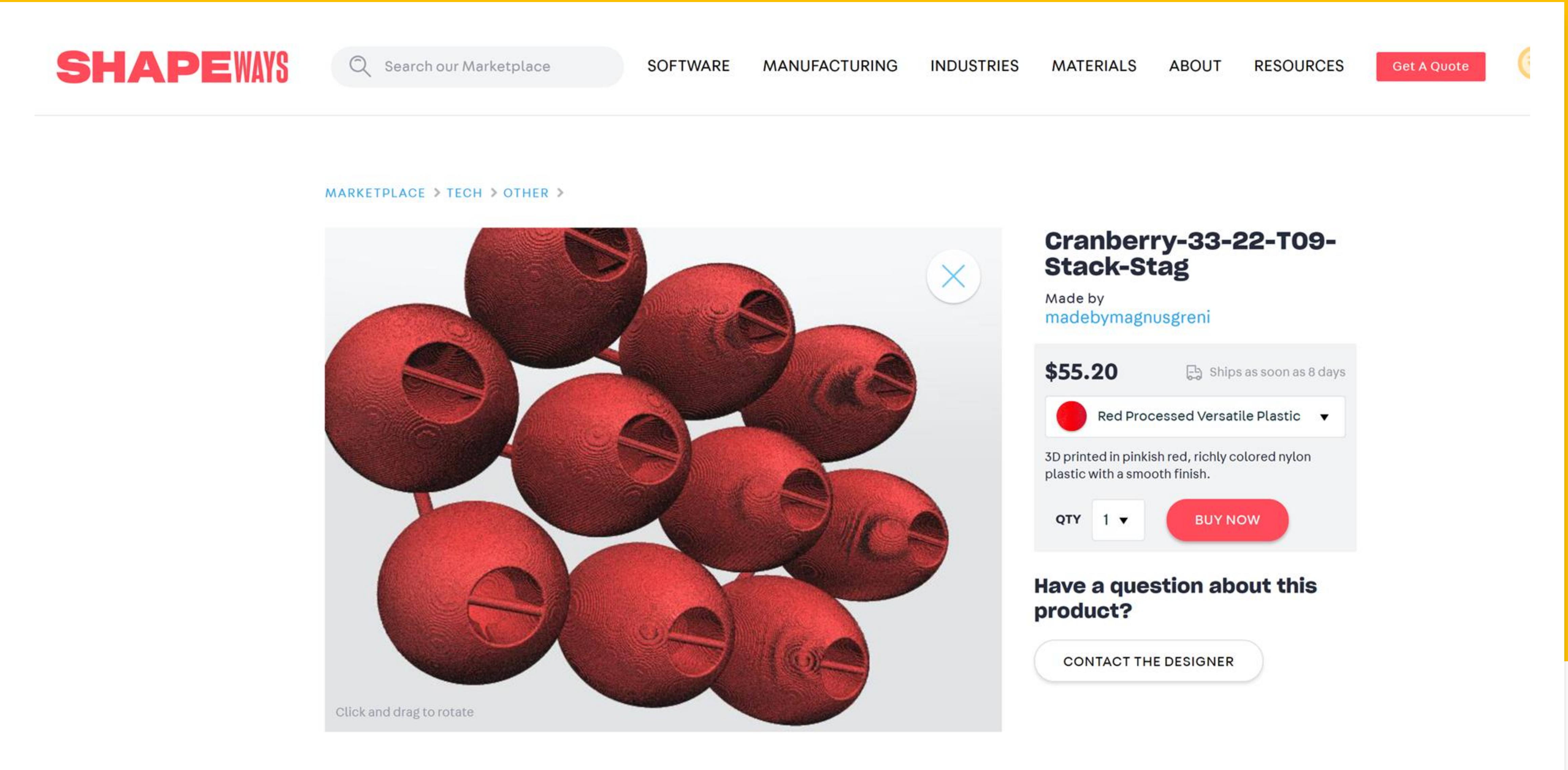
Leaf Wetness Sensor
3666 $99.00

Temperature (Micro) Sensor
NTC thermistor (10K4A1B)
3667S $85.00

Radiation Shield
3663A $90.00



Cranberry-22,5-15-T0,7
$23.54
Shapeways.com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Click and drag to rotate
Cranberry-33-22-T09-Stack-Stag
Made by
madebymagnusgreni
$55.20
Ships as soon as 8 days
Red Processed Versatile Plastic
3D printed in pinkish red, richly colored nylon plastic with a smooth finish.
QTY
1
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Have a question about this product?
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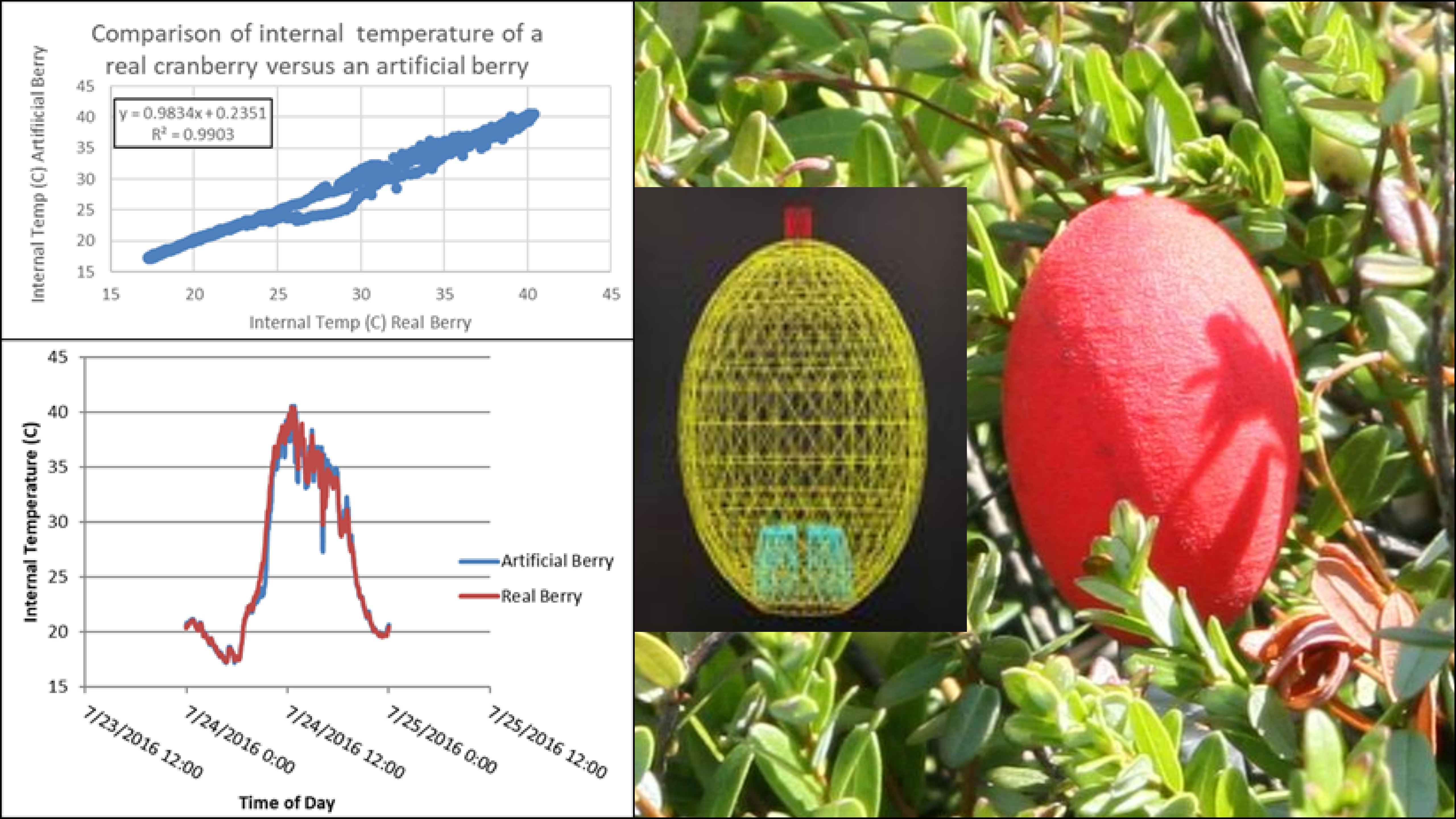
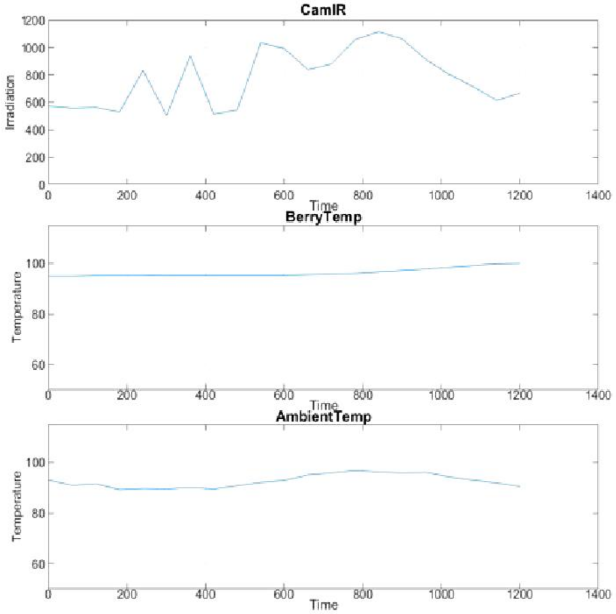
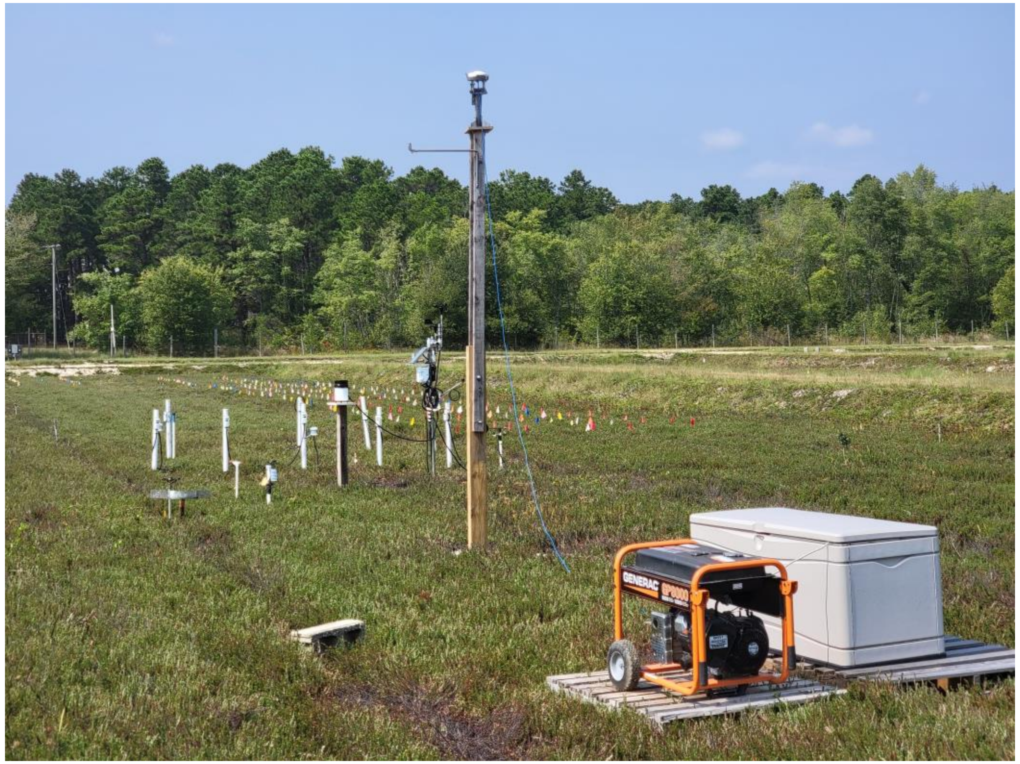
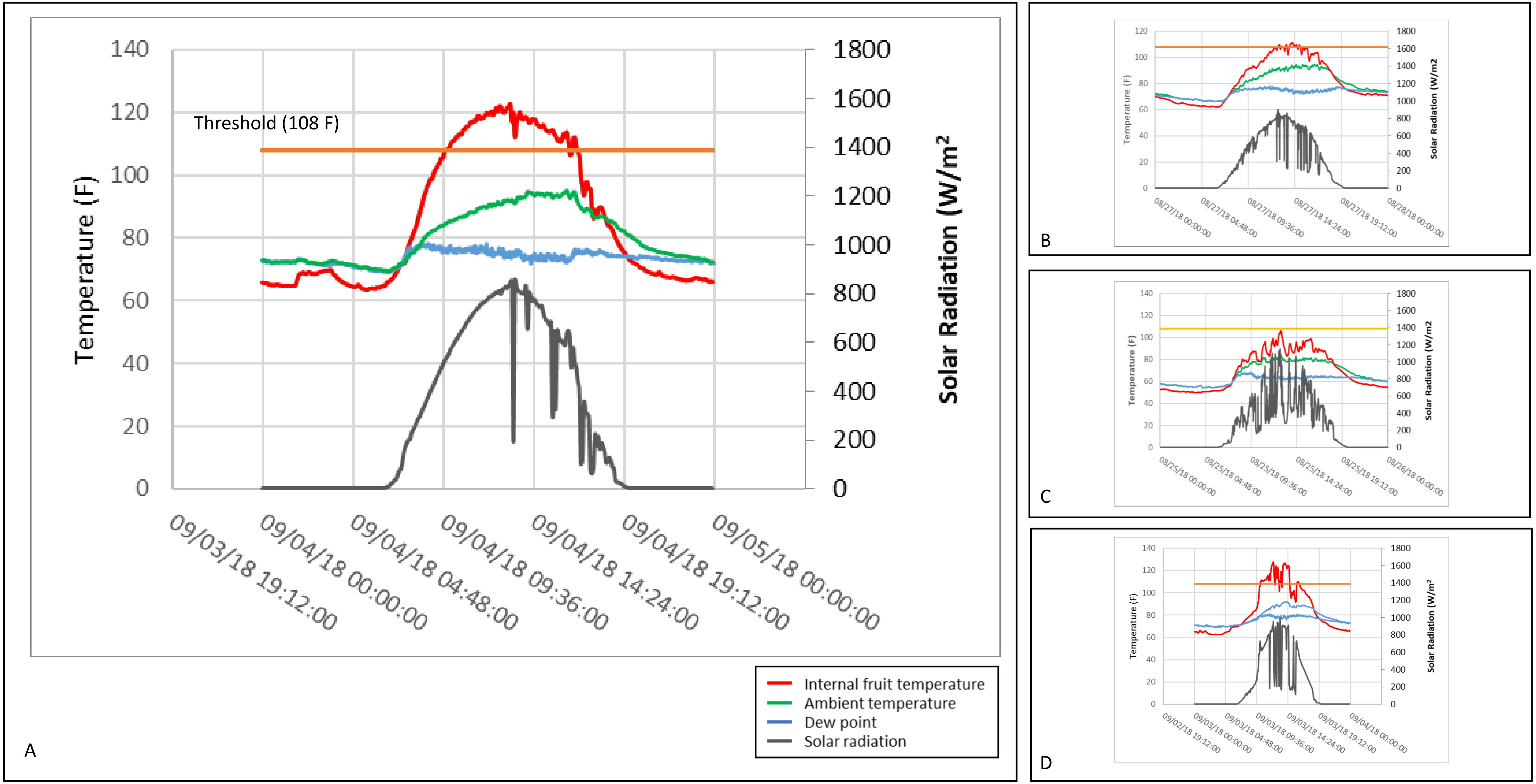

Comparison of internal temperature of a real cranberry versus an artificial berry
y = 0.9834x + 0.2351
R² = 0.9903
Internal Temp (C) Artificial Berry
Internal Temp (C) Real Berry
15
20
25
30
35
40
45
Internal Temperature (C)
Time of Day
7/23/2016 12:00
7/24/2016 0:00
7/24/2016 12:00
7/25/2016 0:00
7/25/2016 12:00
Artificial Berry
Real Berry

Climate, Cloud and Microclimate Monitoring



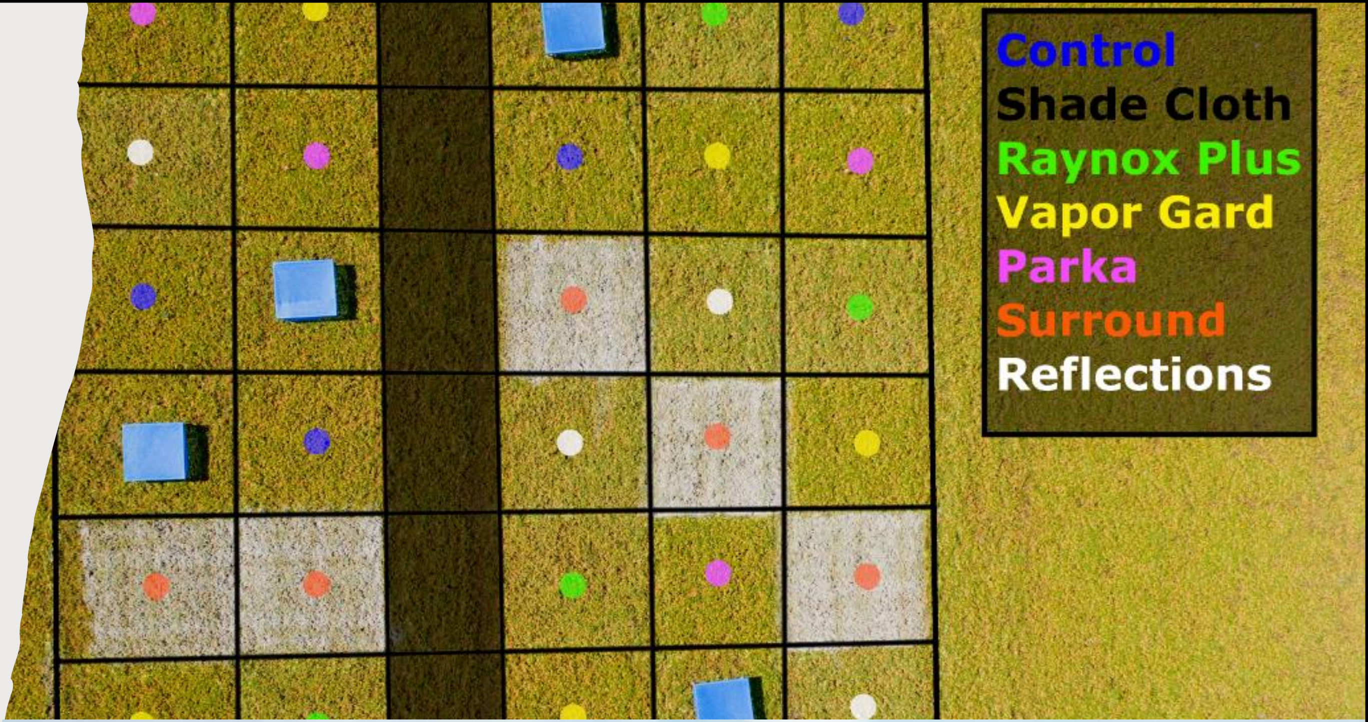




Threshold (108 F)
Temperature (F)
Solar Radiation (W/m²)
09/03/18 19:12:00
09/04/18 00:00:00
09/04/18 04:48:00
09/04/18 09:36:00
09/04/18 14:24:00
09/04/18 19:12:00
09/05/18 00:00:00
Internal fruit temperature
Ambient temperature
Dew point
Solar radiation
A
B
C
D

Field Trials

- Shade Cloth
- Evaporative Cooling
- Protection
- Canopy Structure
- Variety

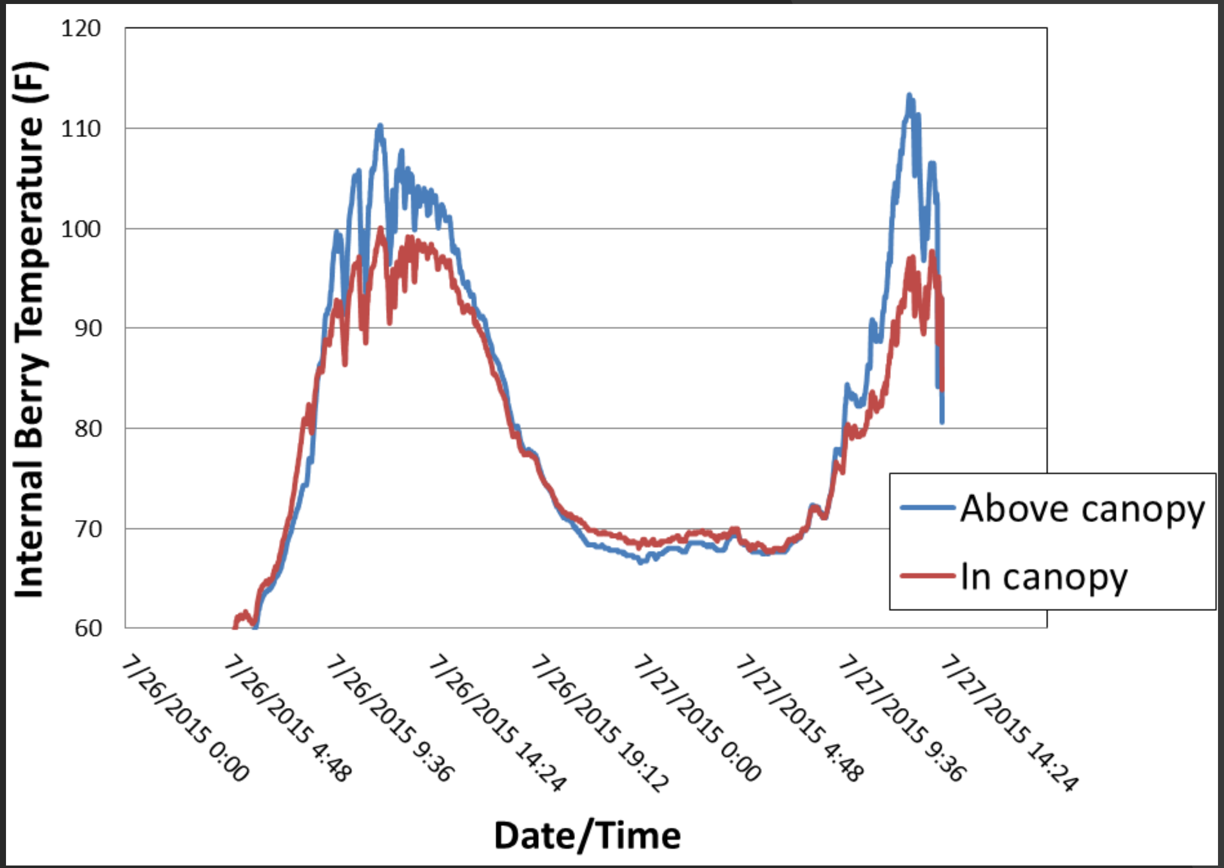


Impact of Shading and Position in Canopy

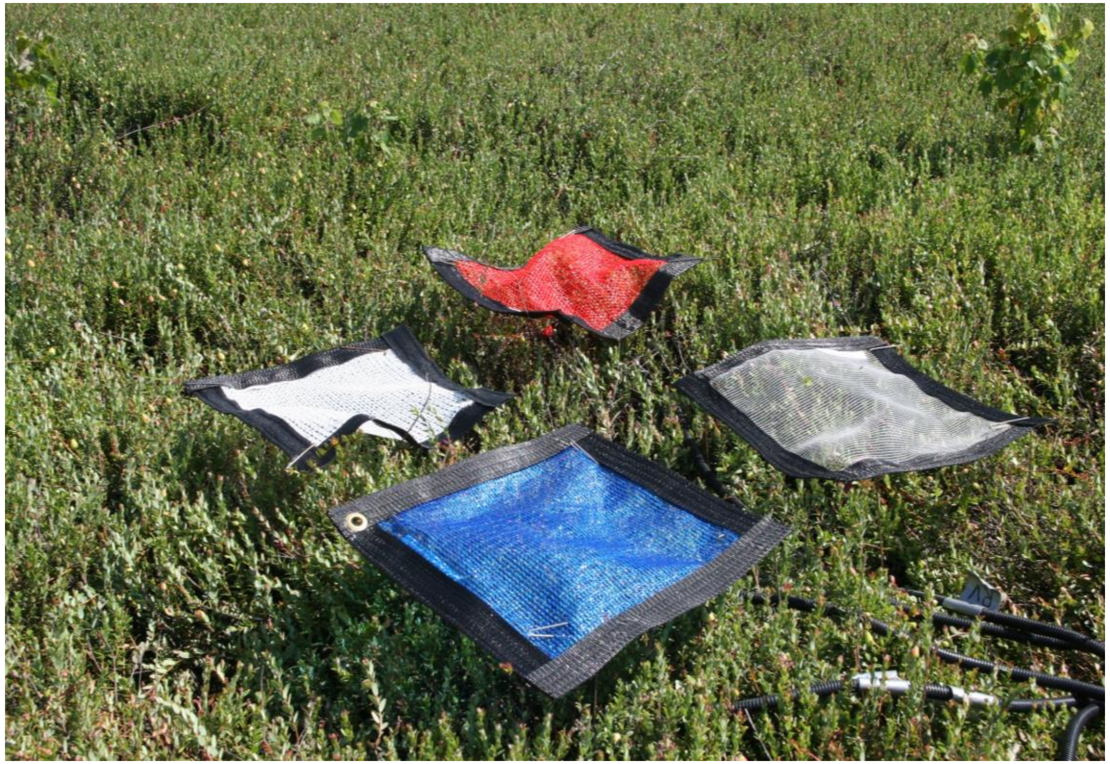
Canopy structure can affect berry exposure

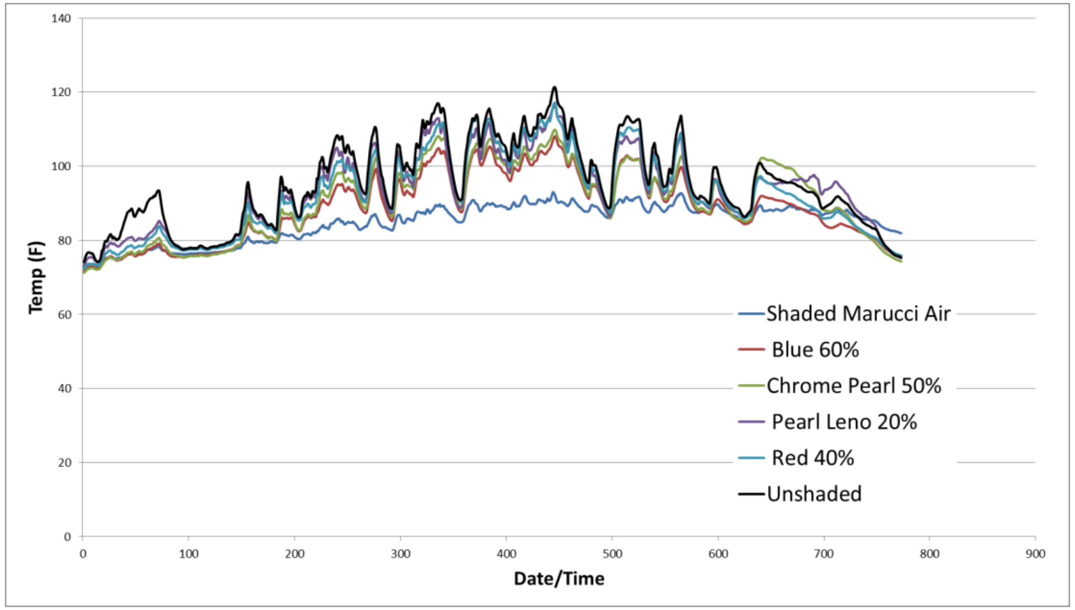
Crop yield can affect berry exposure

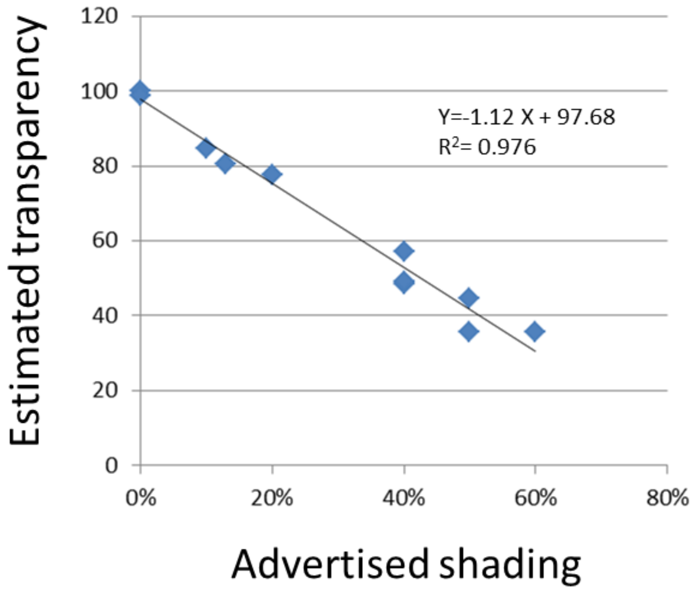
Berry microclimate will impact quality



Shade Cloth Possibilities

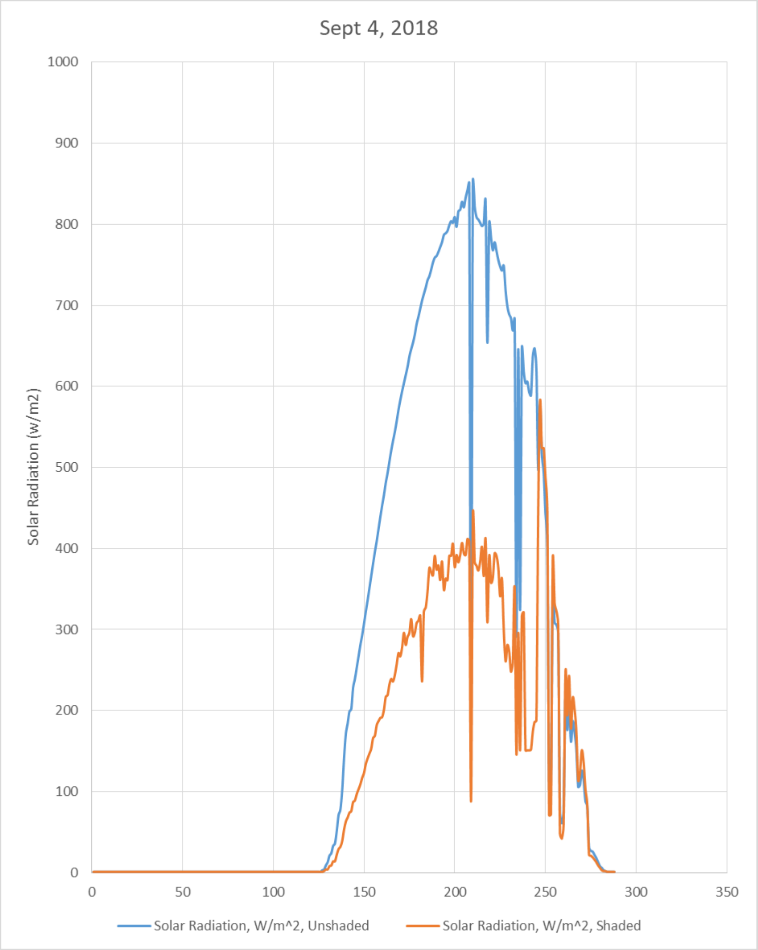


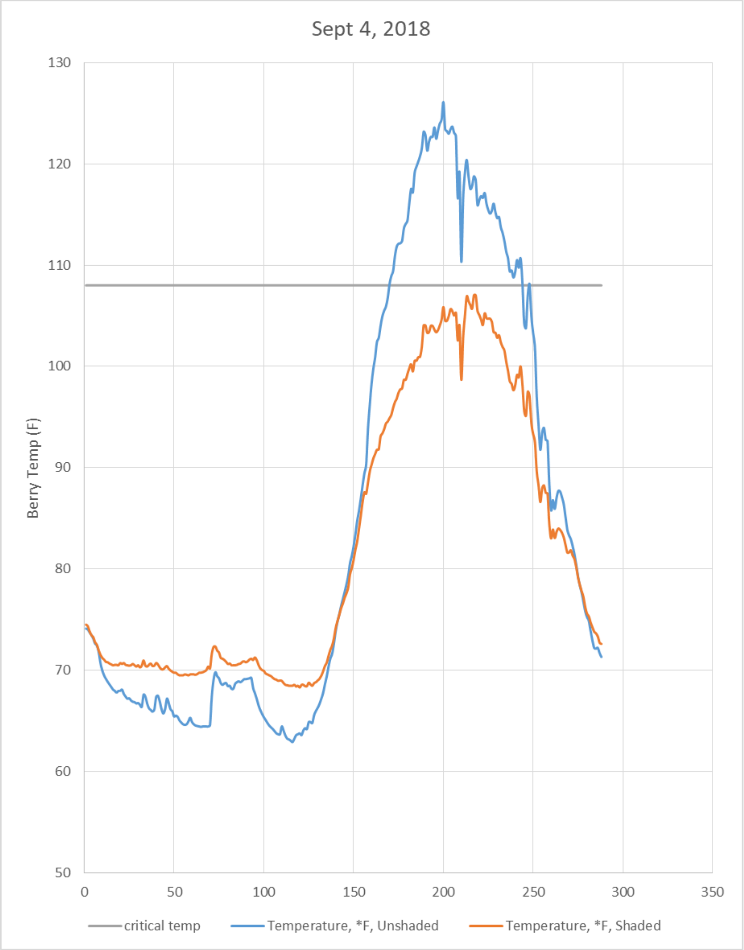




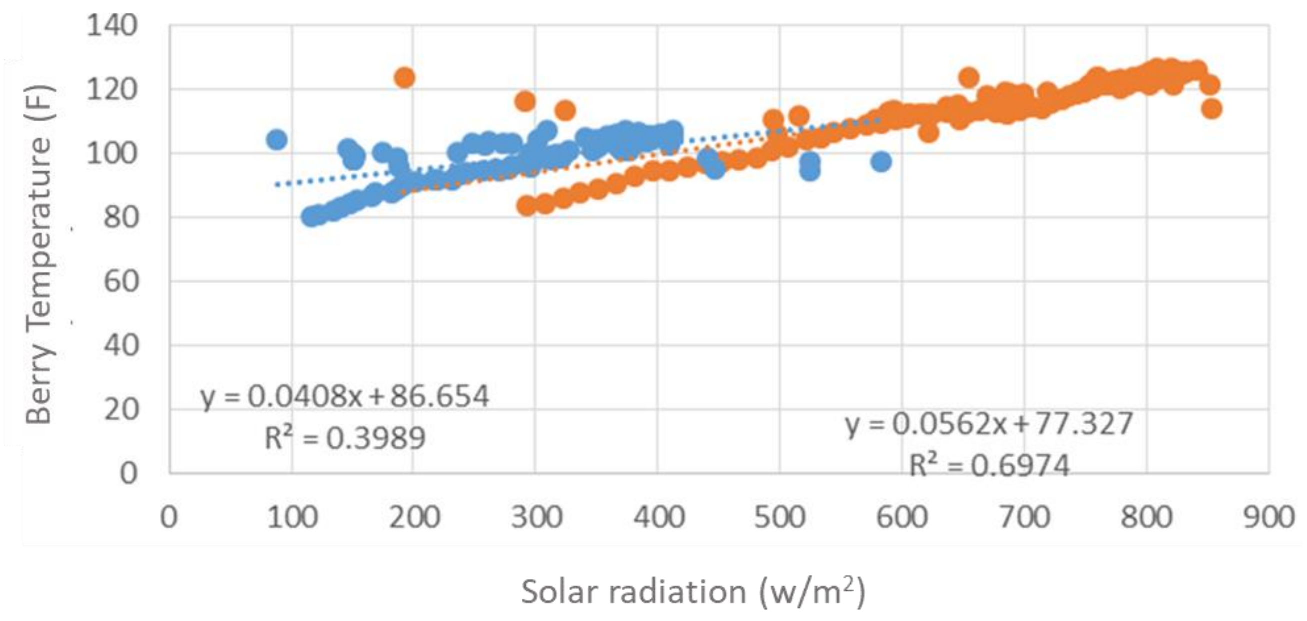
Shade cloth and effect

Effect of shading on internal berry temperature

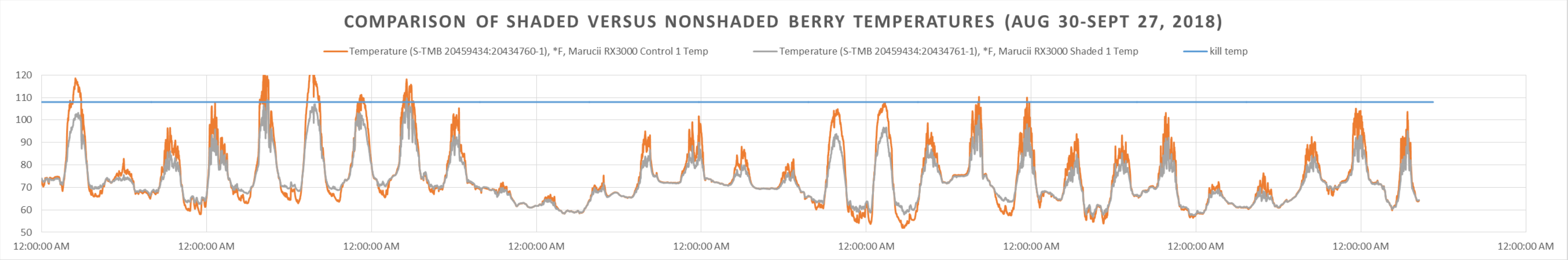




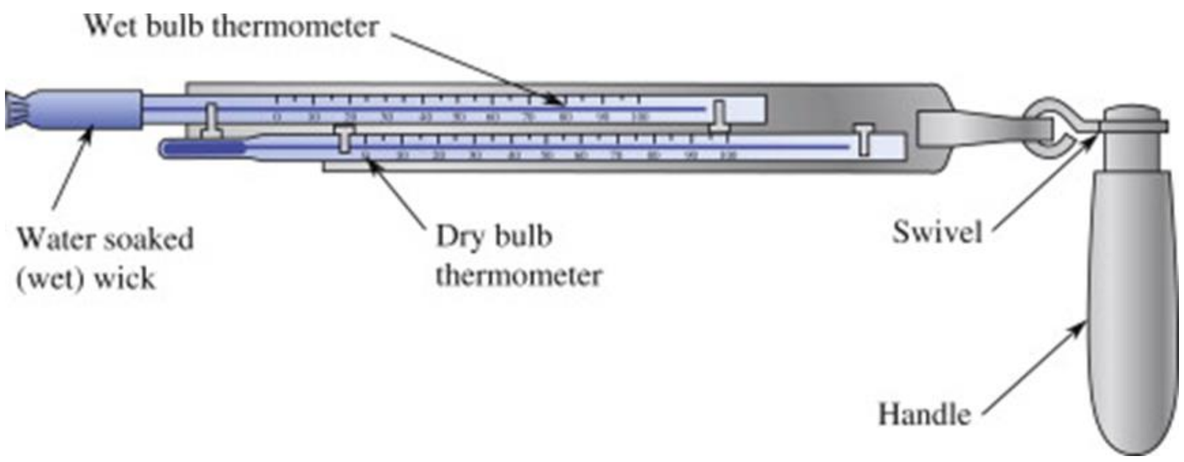
Effect of solar radiation on berry temperature

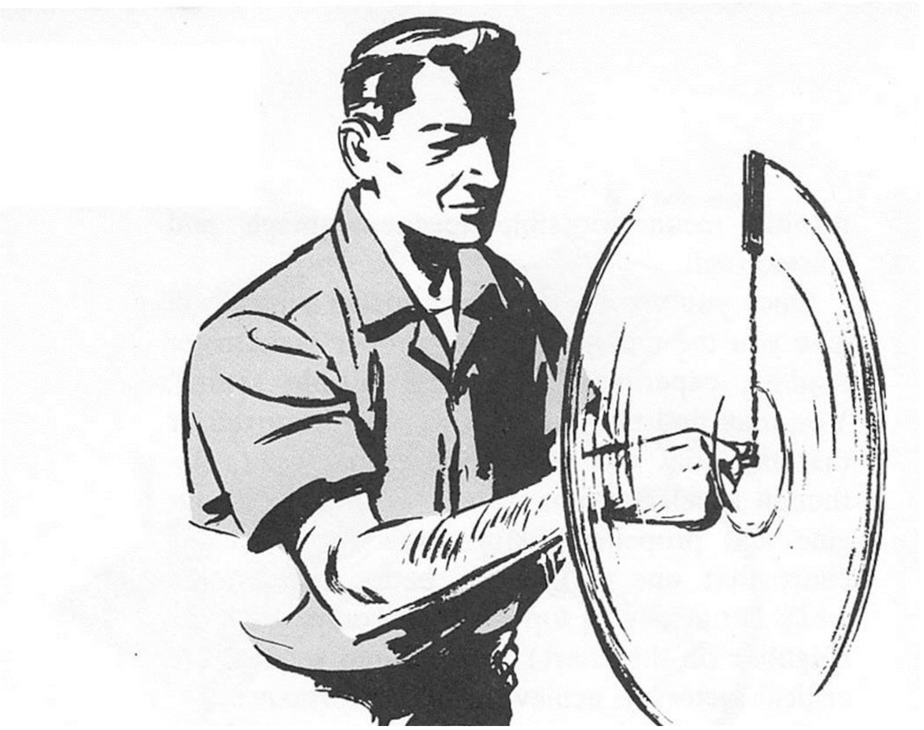


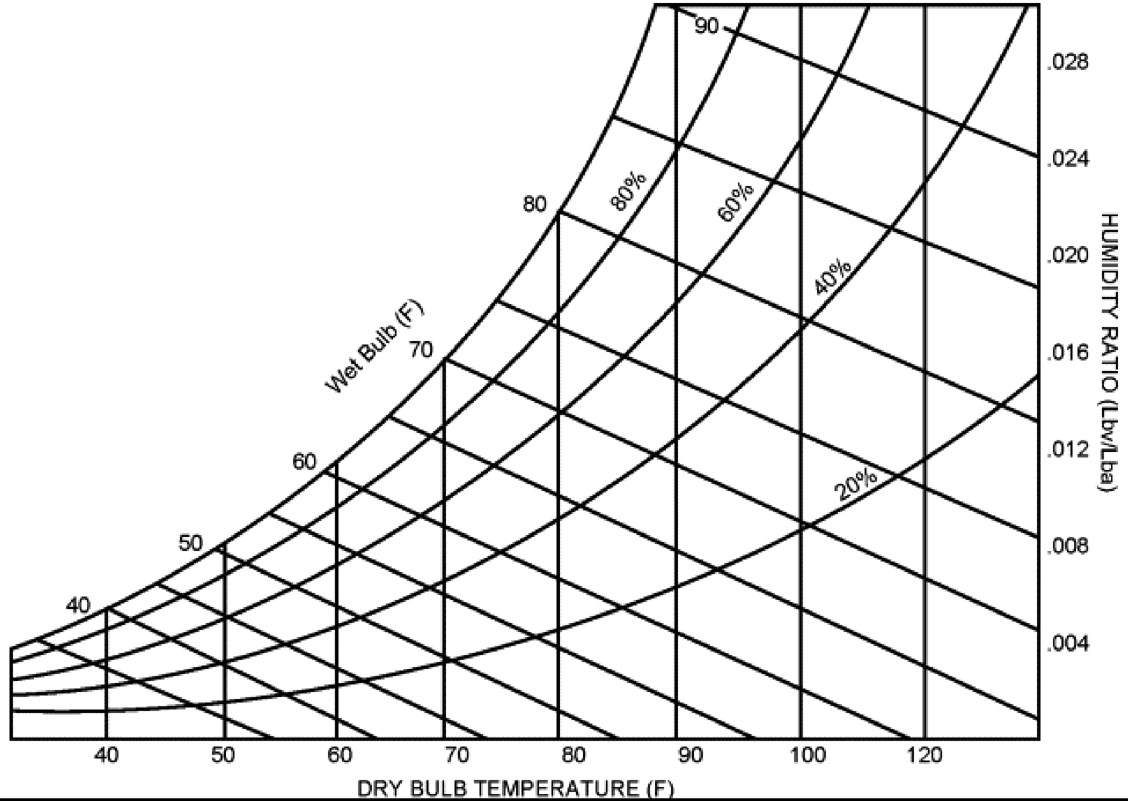
Effect of shading on internal berry temperature



Wet Bulb and Relative Humidity







Wet-Bulb Temperature from Relative Humidity and Air Temperature

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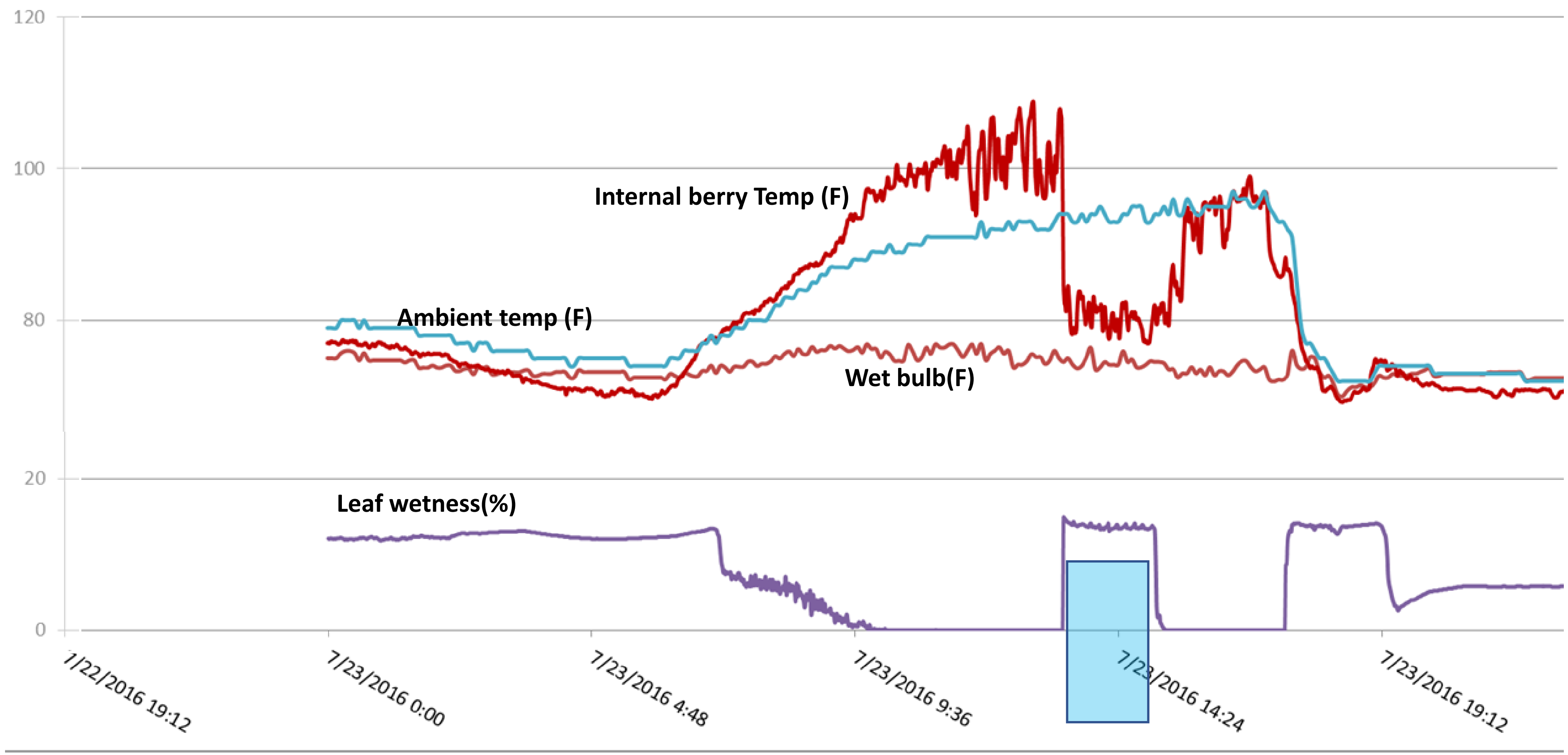
(Manuscript received 14 July 2011, in final form 28 August 2011)

ABSTRACT

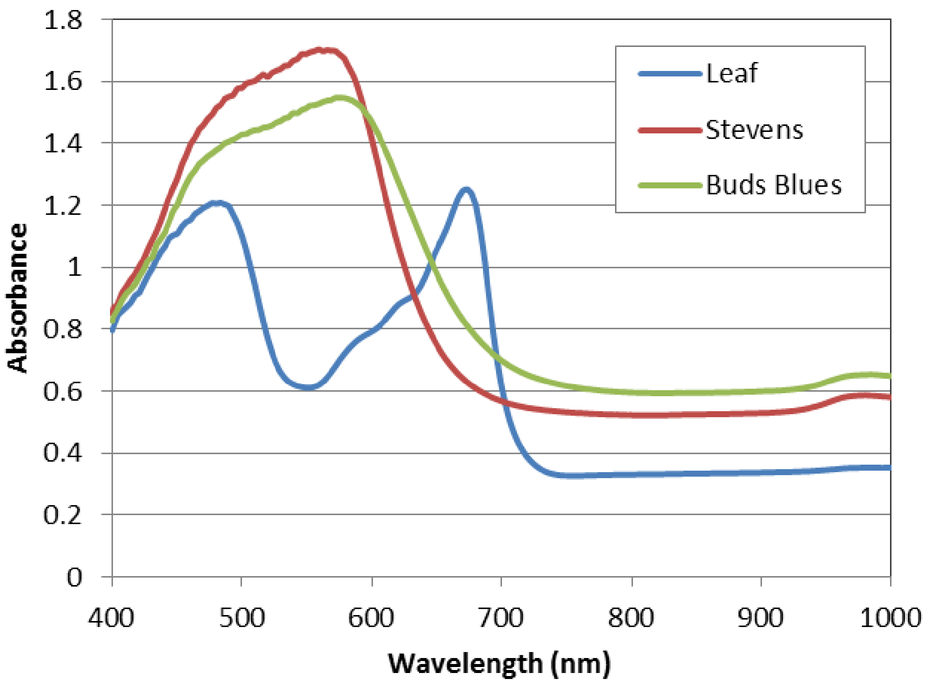
An equation is presented for wet-bulb temperature as a function of air temperature and relative humidity at standard sea level pressure. It was found as an empirical fit using gene-expression programming. This equation is valid for relative humidities between 5% and 99% and for air temperatures between −20° and 50°C, except for situations having both low humidity and cold temperature. Over the valid range, errors in wet-bulb temperature range from −1° to +0.65°C, with mean absolute error of less than 0.3°C.

$$Tw = T \text{ x } \text{atan}(0.152(RH\%+8:314)^{1/2}) + \text{atan}(T + RH\%) - \text{atan}(RH\% - 1.676) + 0.004(RH\%)^{3/2} \text{ atan } (0.023RH\%) – 4.686$$



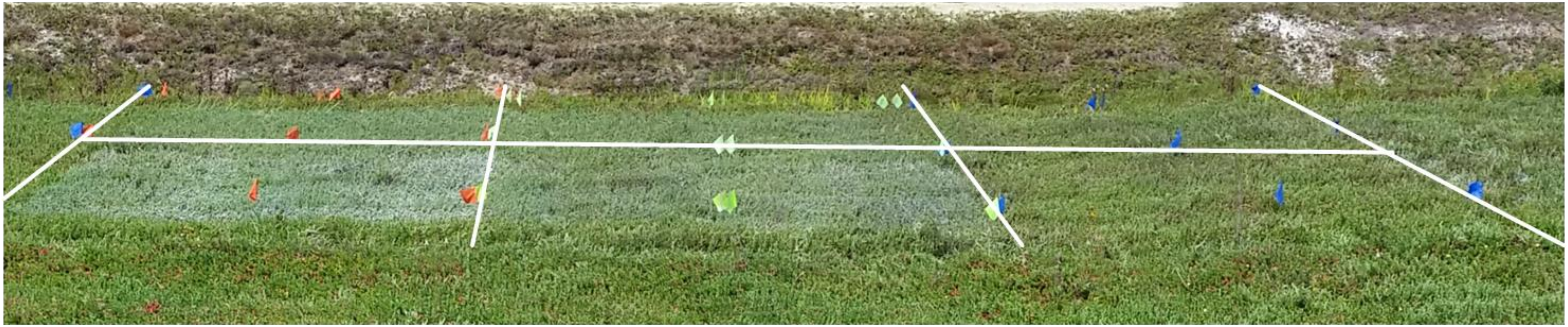
Irrigation and Evaporative Cooling

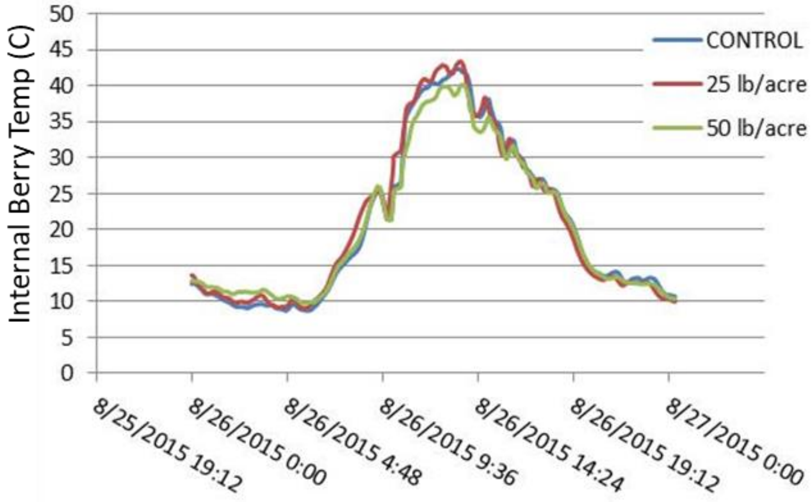
- Relative humidity, dew point and wet bulb temperature

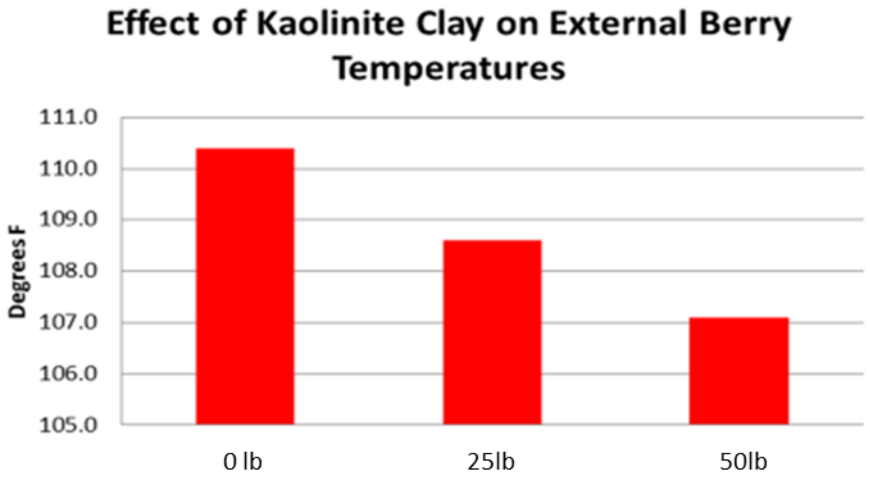


Fruit with distinct genetic backgrounds with differing levels of waxy cuticle (bloom). A) A comparison of the absorption spectra of low wax genotype Stevens (s) versus a high wax genotype Budds Blues (r). B) A comparison of two selections with a waxy layer (right) and without (left)

Surround (Kaolinite Clay)







Scald Forecasting

SCALD FORECAST CHECKLIST

When *ALL* of the following conditions are forecast to be met, a statement concerning cranberry scald potential is warranted based on current experimental evidence.

(1) Dewpoints of 55° F or less during midday and afternoon hours
(2) High temperatures of 80° F or more
(3) Clear or scattered sky conditions during the day
(4) A synoptic situation similar to the examples shown below

SCALD STATEMENT

Weather conditions appear favorable/do not appear favorable for the occurrence of cranberry scald based on experimental evidence.

When conditions are favorable this statement should be included:

The threat of scald may be higher if bog soil moisture is low, if wind speeds are expected to average greater than 10 knots, and no rainfall has occurred during the last 48 hours.

Issuance Period: July 1 through September 30.

- The old way of predicting scald :
- The SCALD FORECAST
- Created and issued daily after the 1990 scald that killed off up to 10% of cranberry crop

Conclusions

- Berry overheating is related to sun exposure
- Ambient temperature is an important factor but not predictive
- Cloud cover is an important factor
- Shading can reduce overheating
- Evaporative cooling is one effective strategy for cooling fruit
- Protectant coatings are limited in benefit