

Hawk-Eye™ Systems*

Hawk-Eye & EYAS

* Turfgrass can talk

Give it voice by autonomously measuring it, 24/7, all year long

Guide cultivation practices

Guide irrigation

Actuate people and equipment

See Results

Keep Measuring the turfgrass

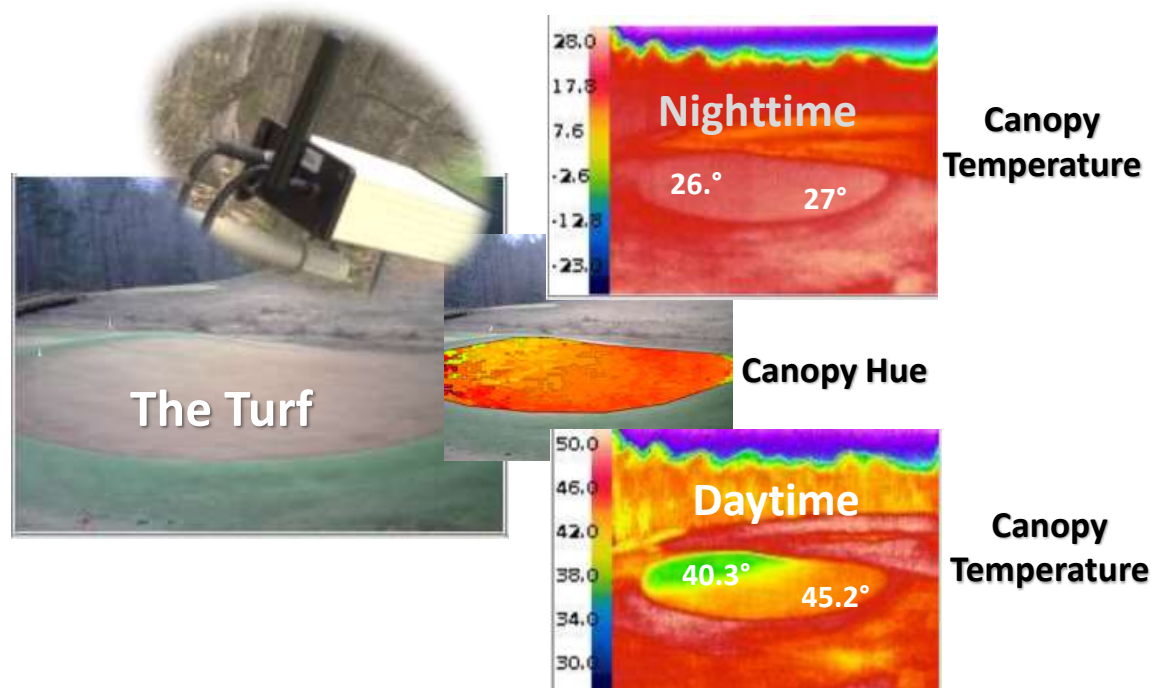


Listen to the grass, it will lead you to financial and environmental sustainability

add \$\$\$\$ to the maintenance budget by avoiding unneeded costs

Get the return on your investment in less than one season

Thermographic & Visual Image Data of Turf



The Images, Measurements, and Notices show and tell where to:

Target Labor

Target Disease and Pest Treatments

&

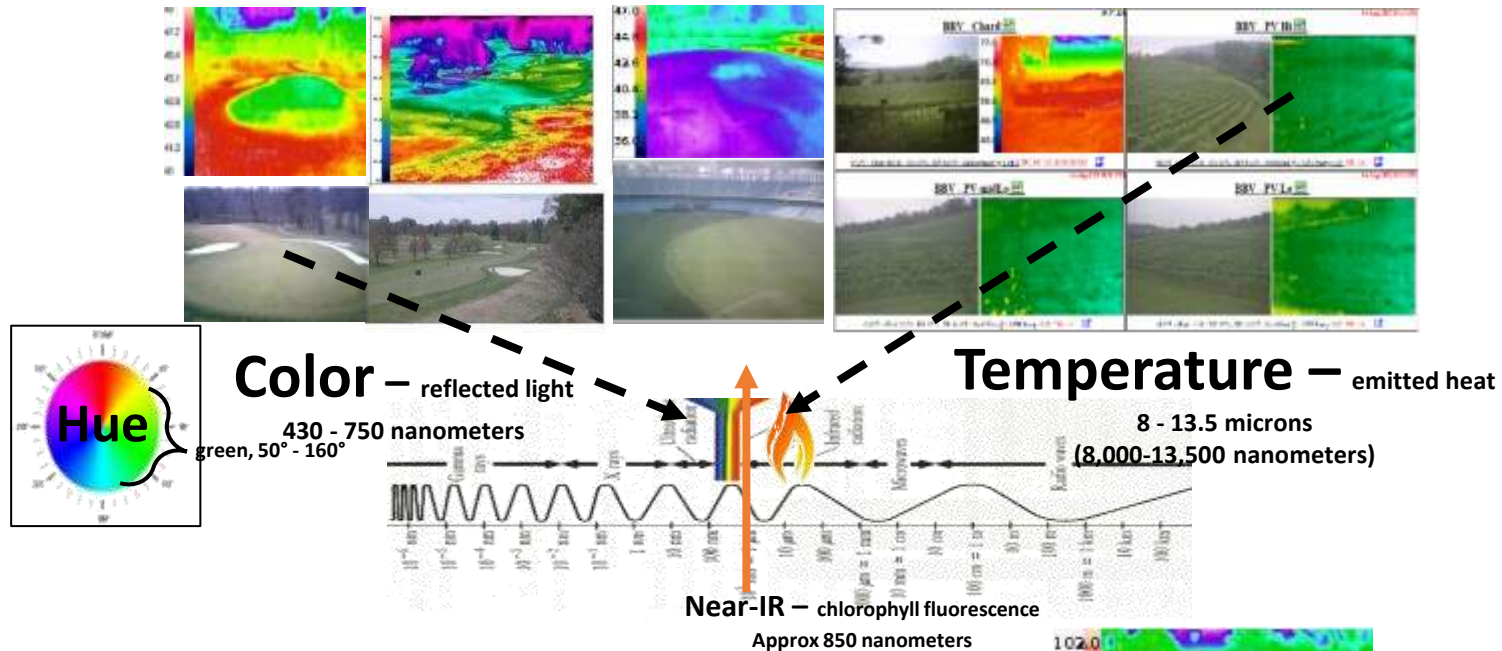
See Turfgrass Water Status & Guide Irrigation

Don't use unneeded electricity

Introduction

**Measuring & Controlling Stress & Hue
to Reach Cultivation & Contract Goals**

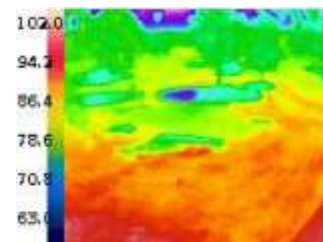
The Agricultural Imaging Spectrum



Color (Hue°) & Uniformity (Std-Dev of Color)
= **QUALITY (1-9) & Infers N,P,K**



Temperature Infers
Photosynthesis
Respiration
Evaporation/Moisture
Plant Water Status

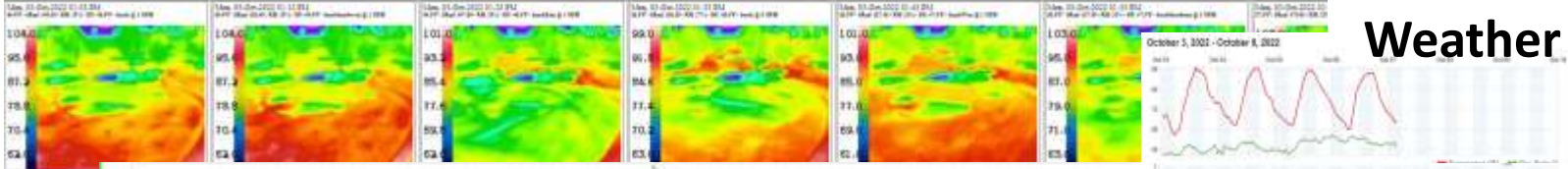


Persistent Imagery & Data

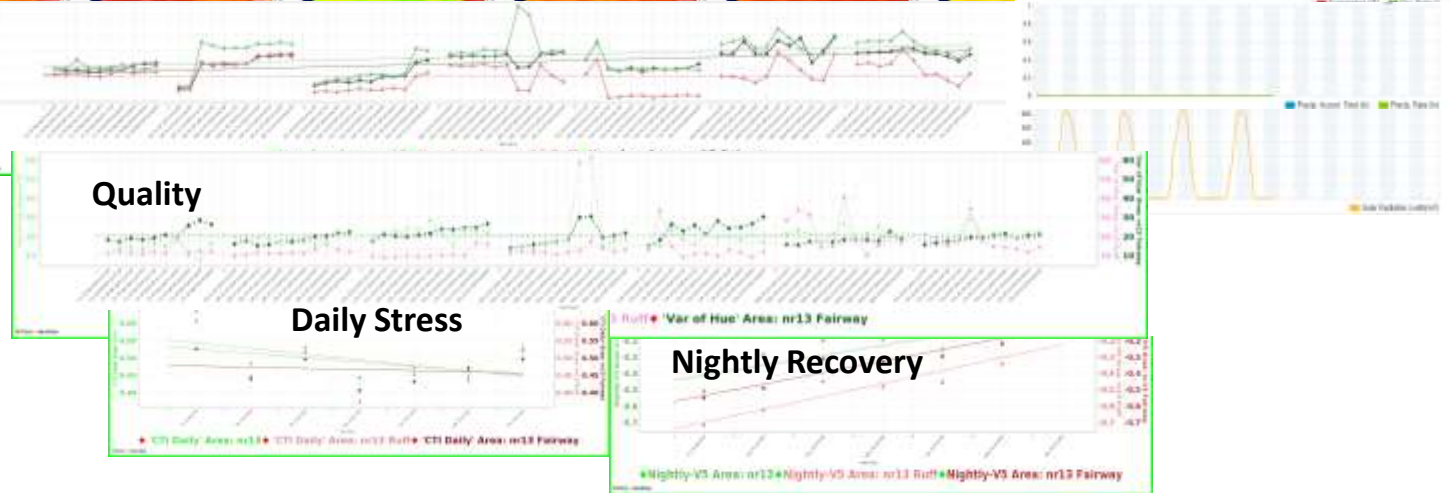
Images



Weather

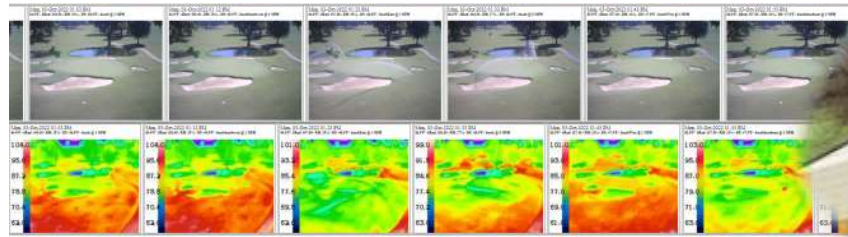


Data



Persistence is Critical
But, it's Lots of Pictures & Data

Distill Lots of Pictures & Data



Into Actionable Information

From: Hawk-Eye

To: e-mail and/or phone @ sunset

Nr13 Fairway Zone 3 & 4 **IRRIGATE** Daily Stress >0.60

Add a turn to sprinkler

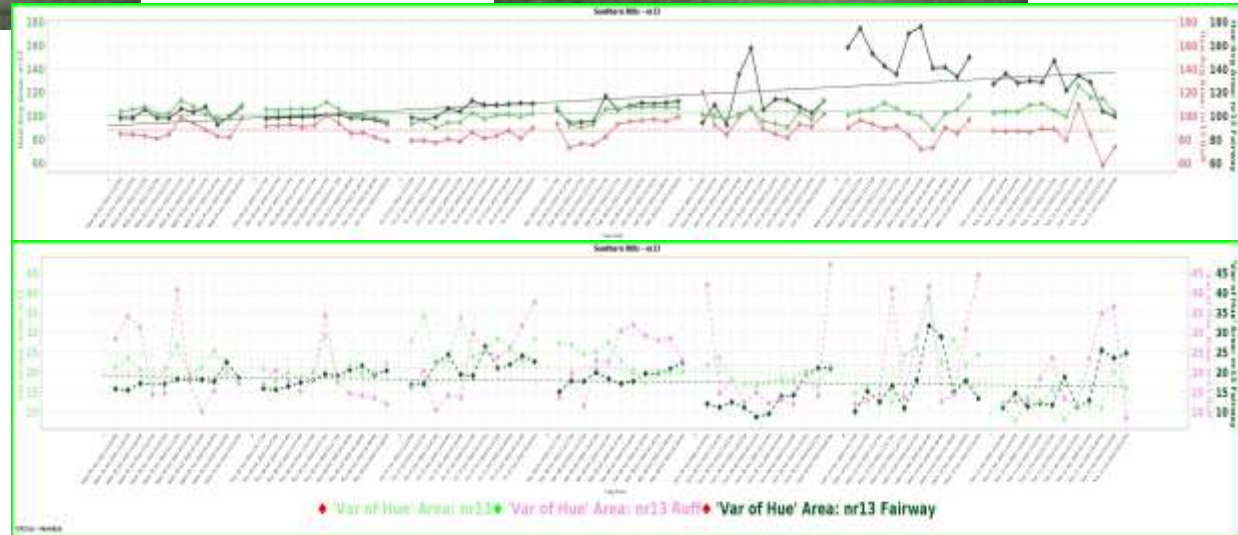
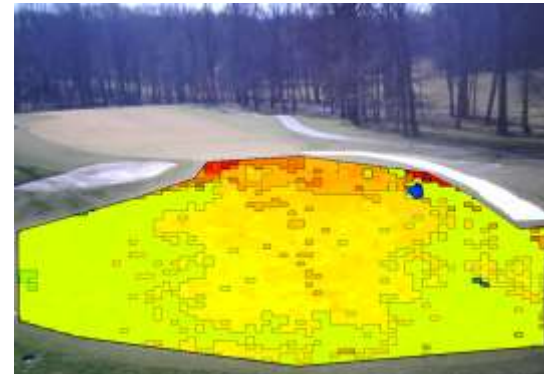
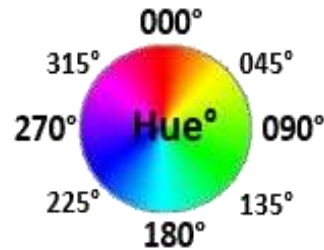
From: Hawk-Eye

To: e-mail and/or phone @ 1:15 PM

nr15green **Color** is declining toward yellow

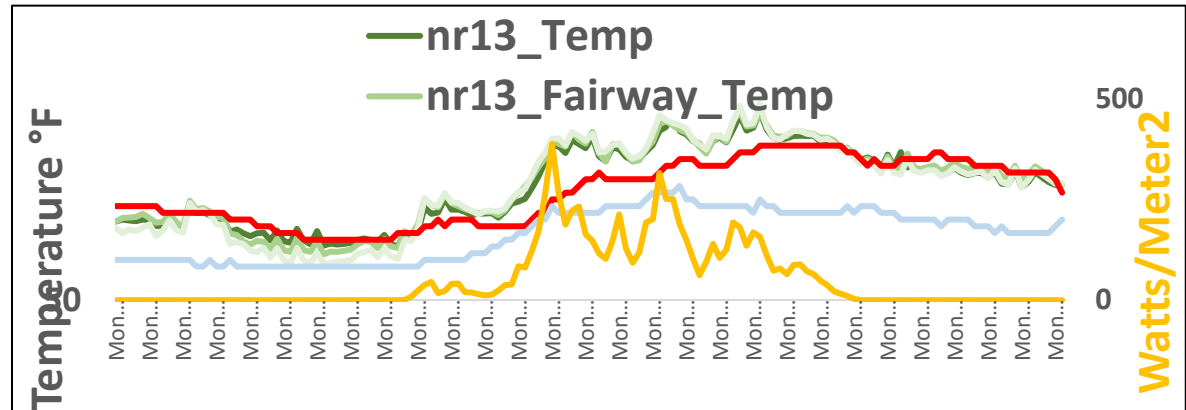
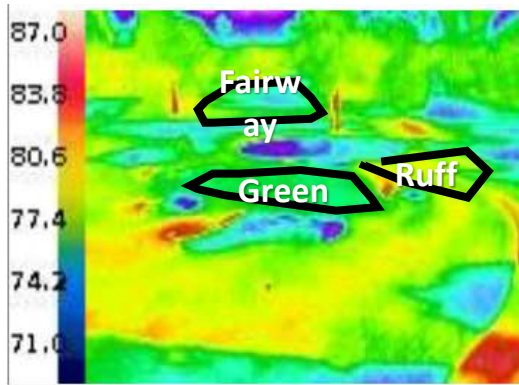
Look at it & consider N

Using Visual Images & Quality Indices

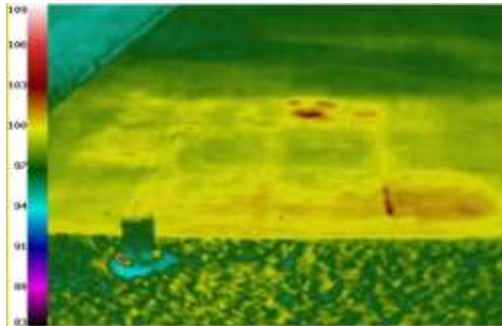


Using Temperature Images

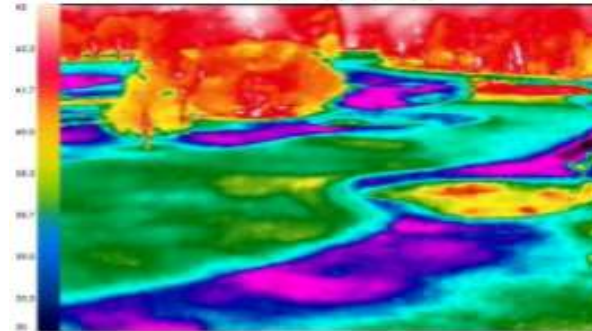
Day & Night



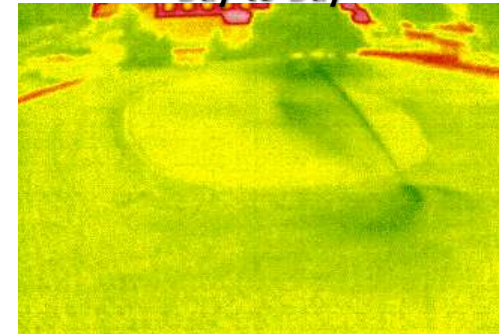
Research



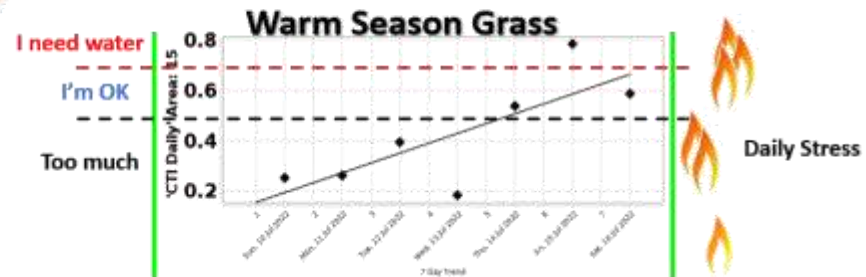
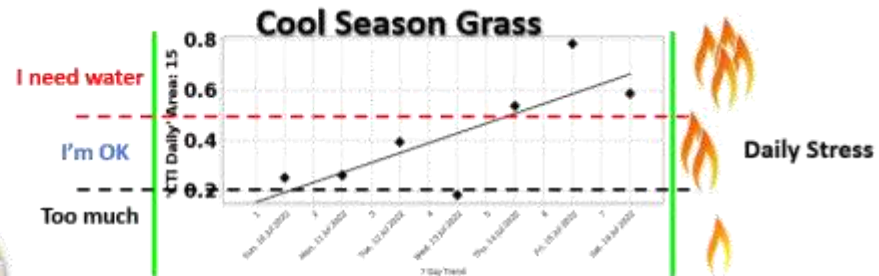
Maintenance



Day-to-Day



Using Temperature for Stress Indices*

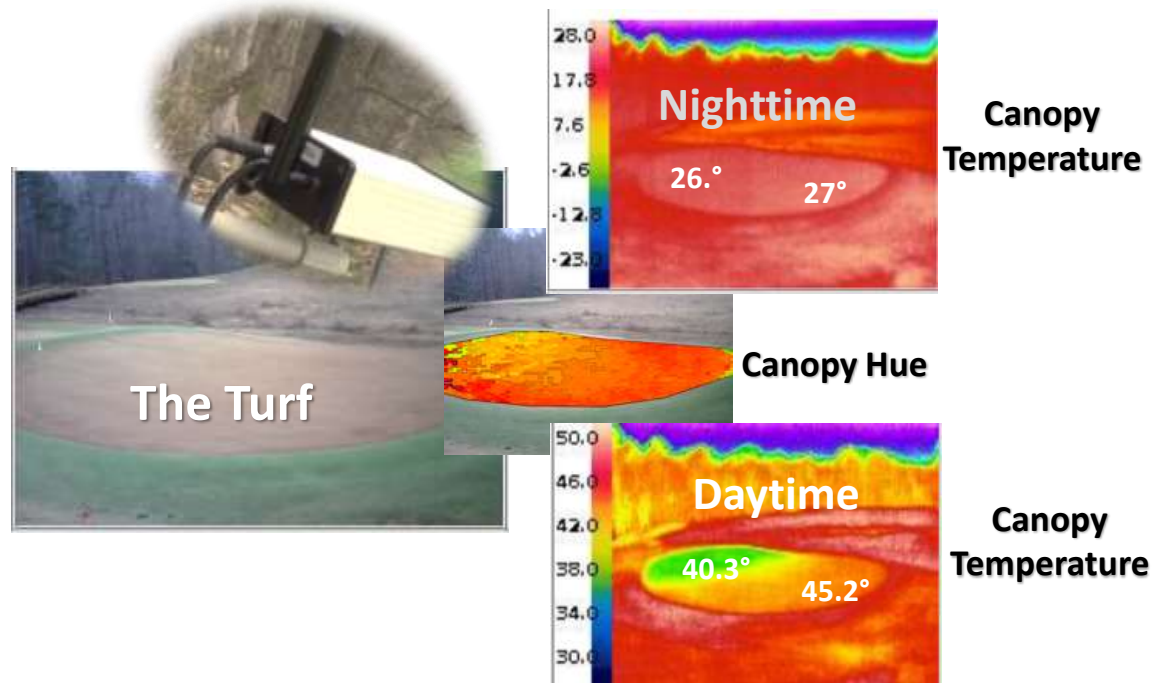


Irrigation = Water + Electricity + Pump Hours = Turfgrass Health

* The Stress Index is derived from our version of the CWSI

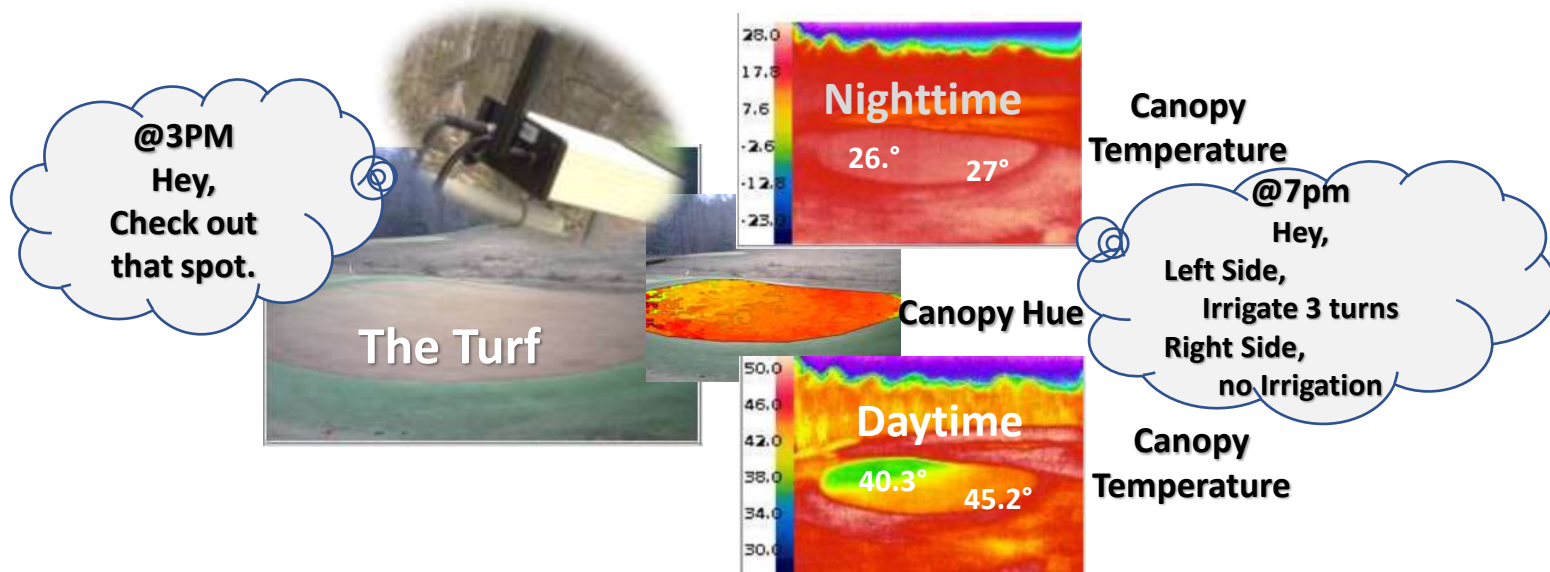
The System

Thermographic & Visual Image Data of Turf

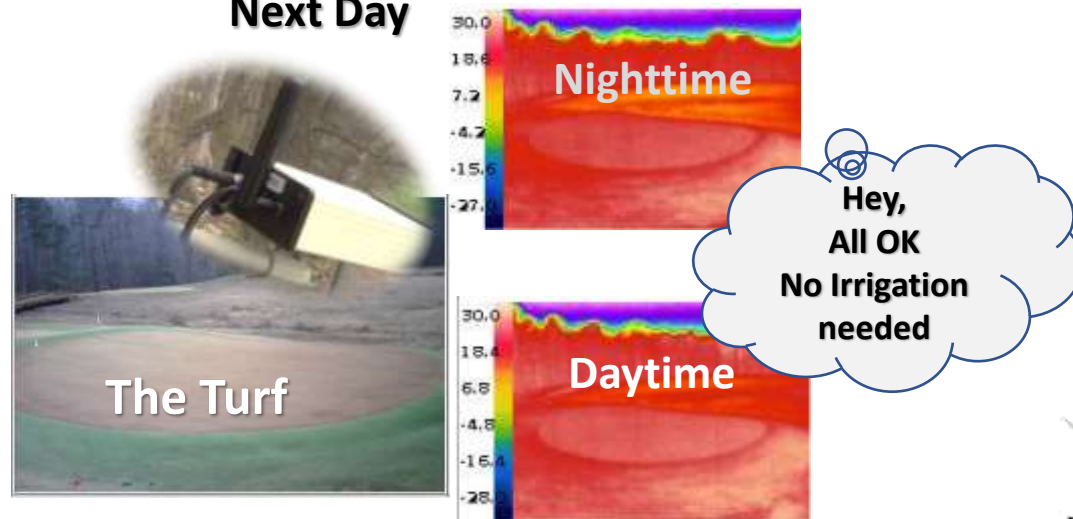


The Images and Measurements show and tell where to:
Target Labor and Deeper Investigations
Target Disease and Pest Treatments
&
See Crop Water Status & Guide Irrigation

Actuate People & Equipment



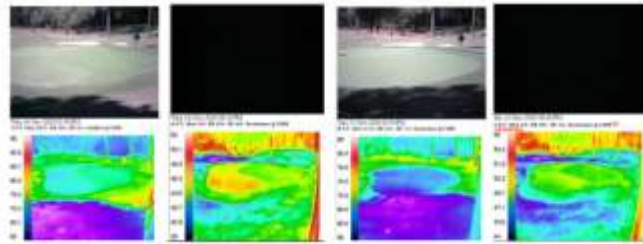
Next Day



Hawk-Eye™ System

EYAS &/or Hawk-Eye

It's not how the pictures look



Images

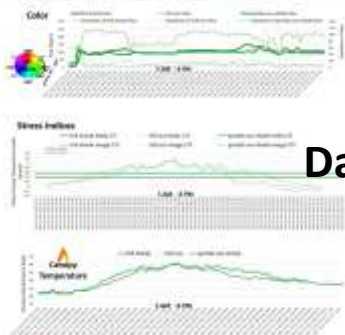
Measuring HUE°

Measuring Canopy Temperature

Autonomously

24/7/365

It's about the measurements
and the information in them.



Data

Actionable Guidance

And how easy it is to use.

Hawk-Eye™ e-mail When you want to know

[Search Image Data Archive](#)

[Set Notices](#)

[Weather Sites](#)

[Hawk-Eye Notes](#)

[Hawk-Eye Dashboard](#)

[How-To Hawk-Eye](#)



From: Hawk-Eye

To: e-mail and/or
phone

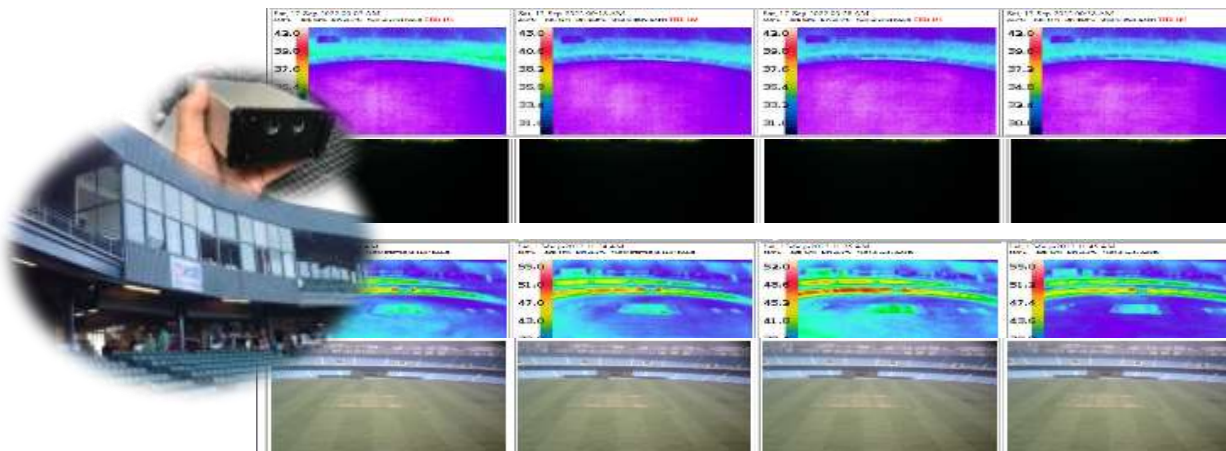
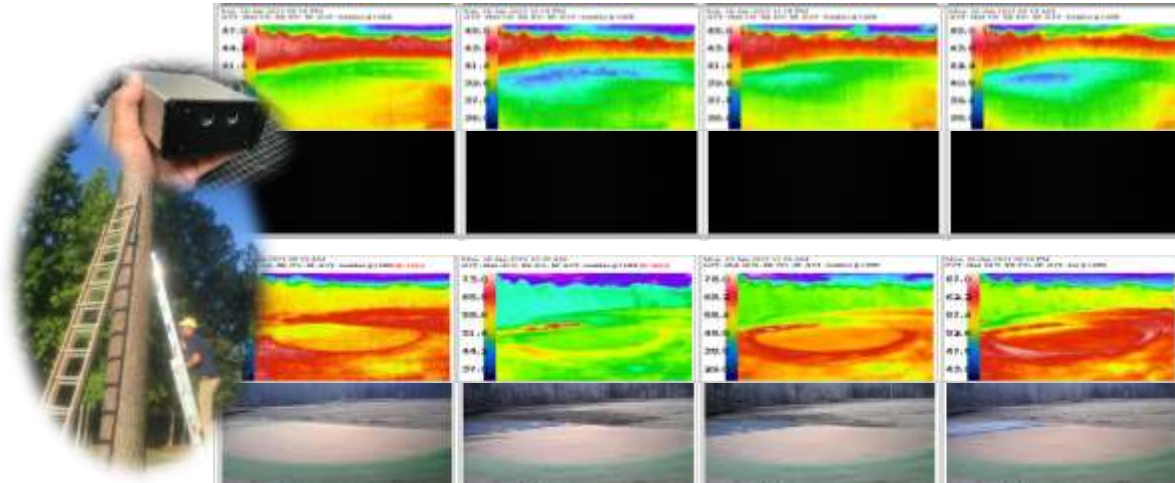


Hawk-Eye™
Latest Site Images



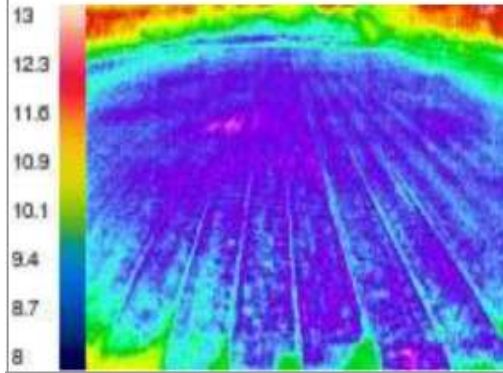
Use Cases

See and Measure the Grass Be Informed and Take Action

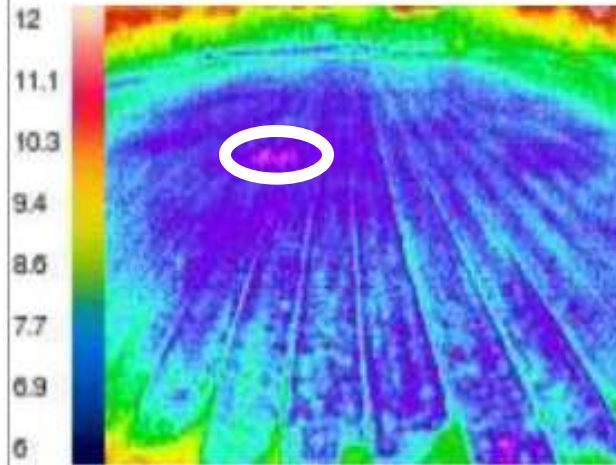


Sometimes it starts with What's This ?

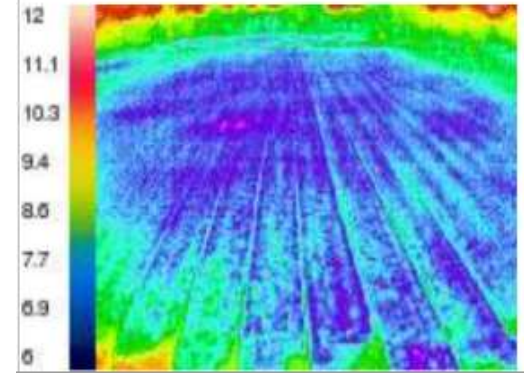
Mon, 23-May-2022 02:22 AM
11.1°C - SRad: 0.00 - RH: 83% - DP: 8.3°C - West @ 0 KM/H



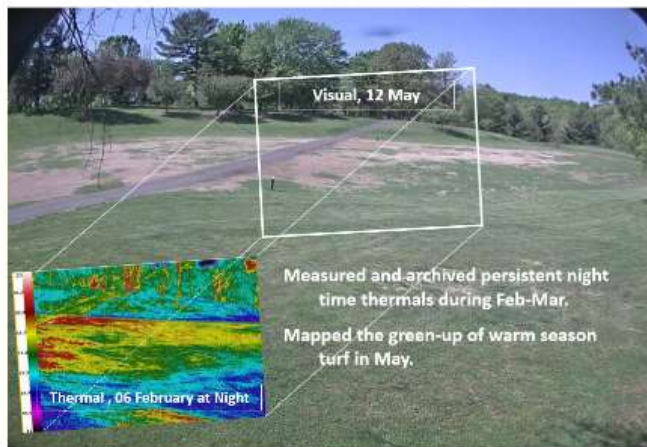
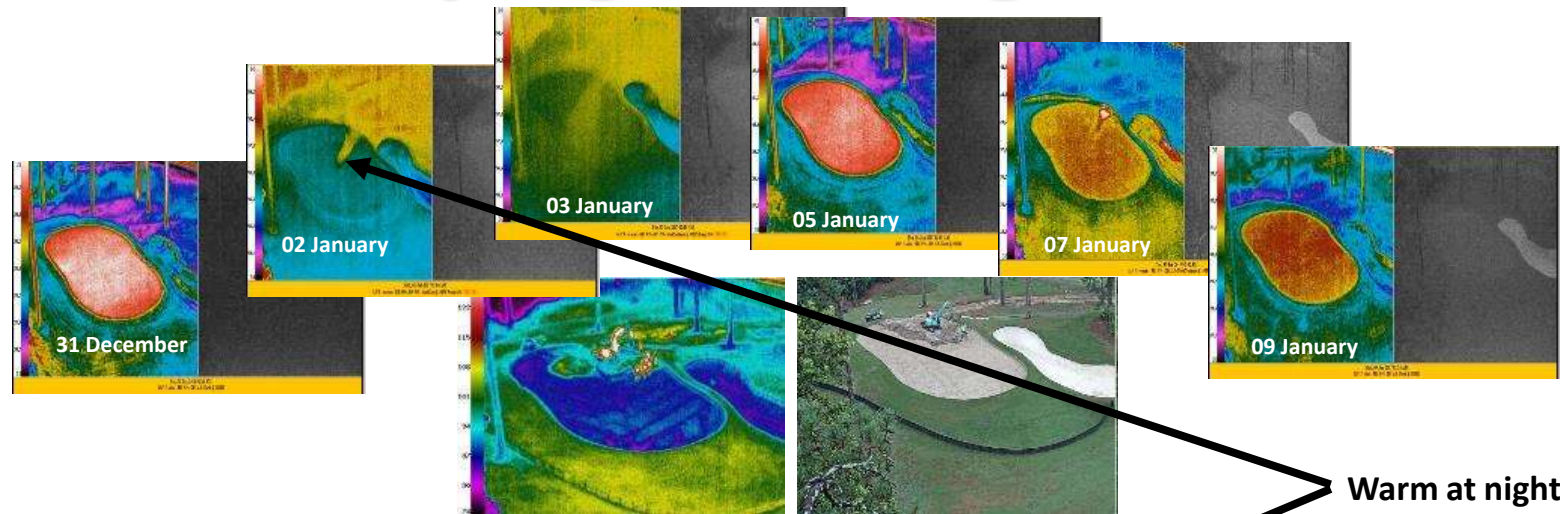
Mon, 23-May-2022 02:32 AM
11.1°C - SRad: 0.00 - RH: 83% - DP: 8.3°C - West @ 0 KM/H



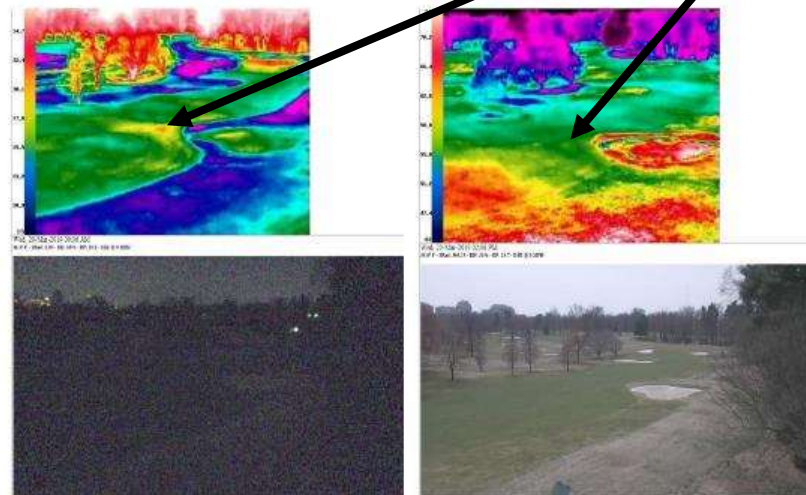
Mon, 23-May-2022 02:42 AM
10.6°C - SRad: 0.00 - RH: 84% - DP: 8.3°C - West @ 0 KM/H



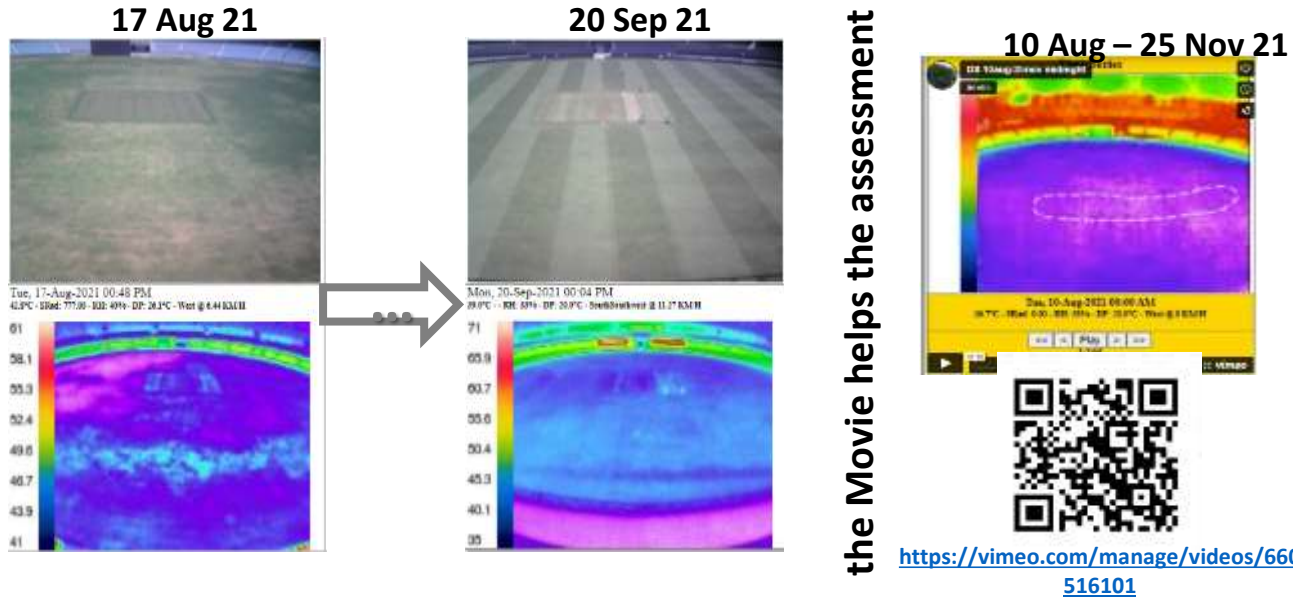
Identifying Drainage Issues



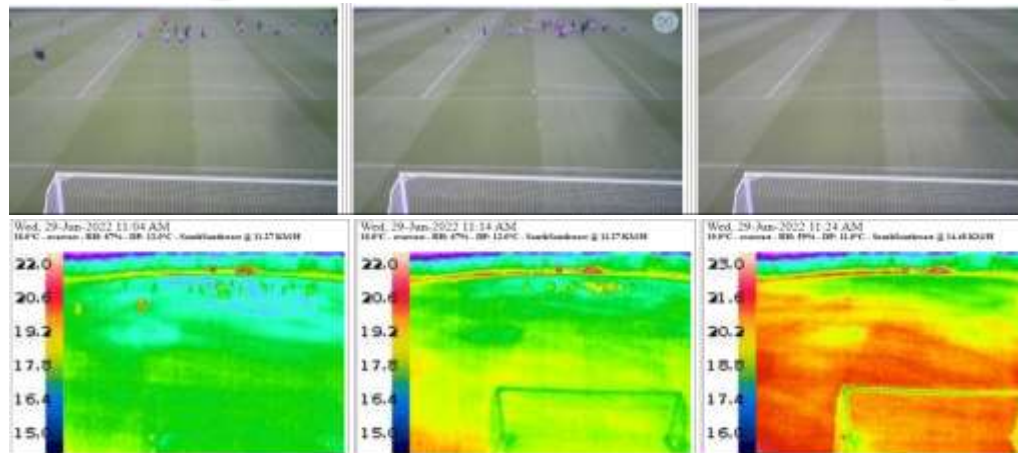
The Cause of Winter Kill



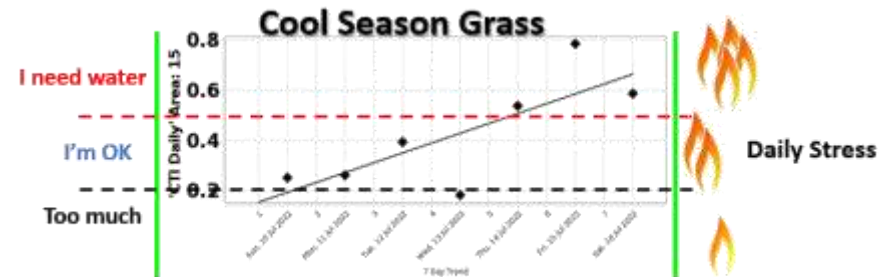
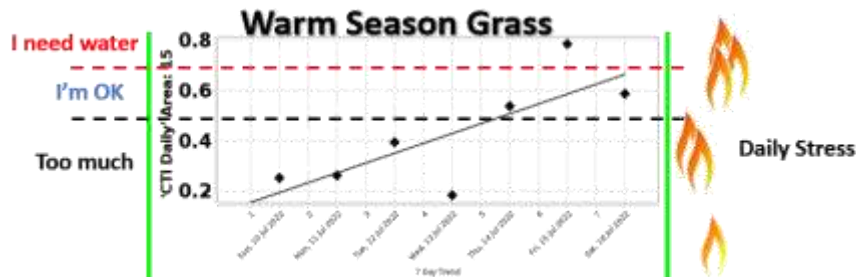
Checking Sprinkler Heads



Irrigation Uniformity



Guiding Irrigation



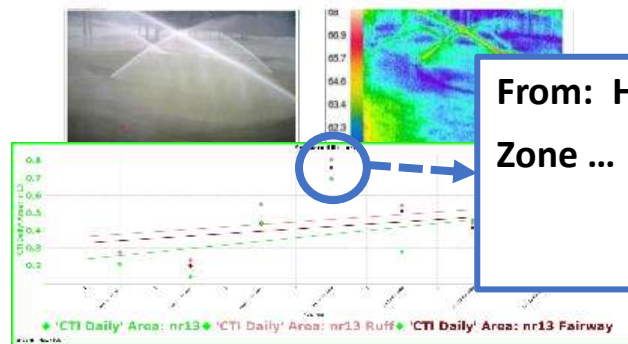
Use your regular irrigation schedule.

When you irrigate today, let the System tell you if you should:

add water

or

take away water

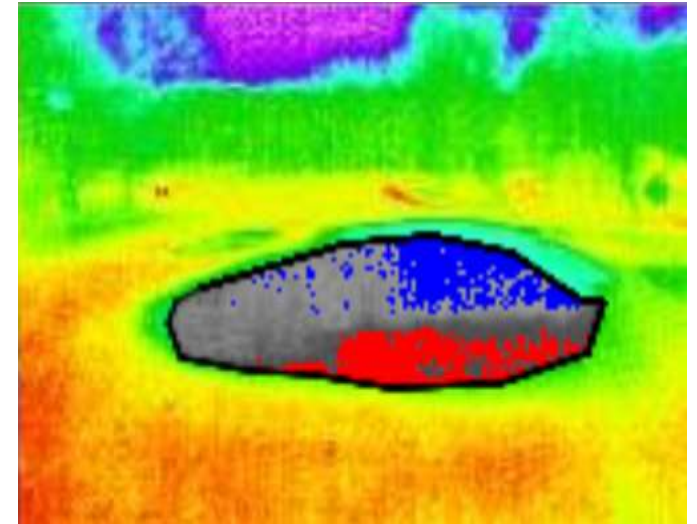
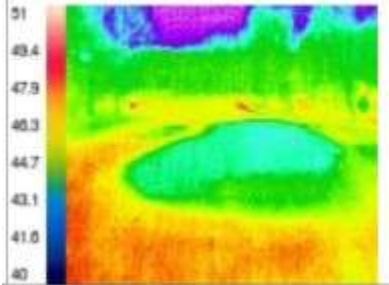


Assessing Compaction & its Remediation

Tine &/or Adjust Irrigation



Mon, 25-Jan-2021 01:20 PM
36.0° F - SRad: 79.30 - RH: 53% - DP: 21.0 - East @ 0.3 MPH



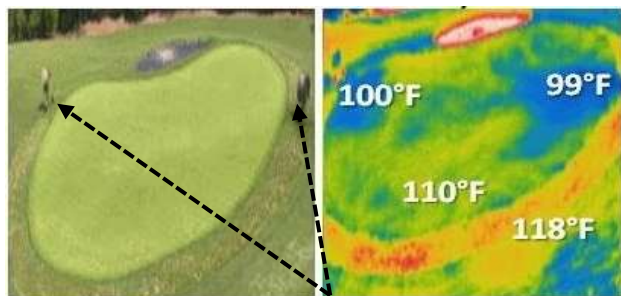
36.0° F - SRad: 79.30 - RH: 53% - DP: 21.0 - EastSoutheast @ 1 MPH



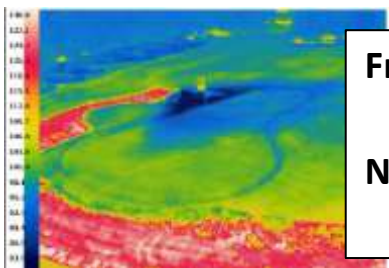
a Fan is Effective for Cool Season Grass

Set-Up Your System and know ...

When the Fan is aimed well.

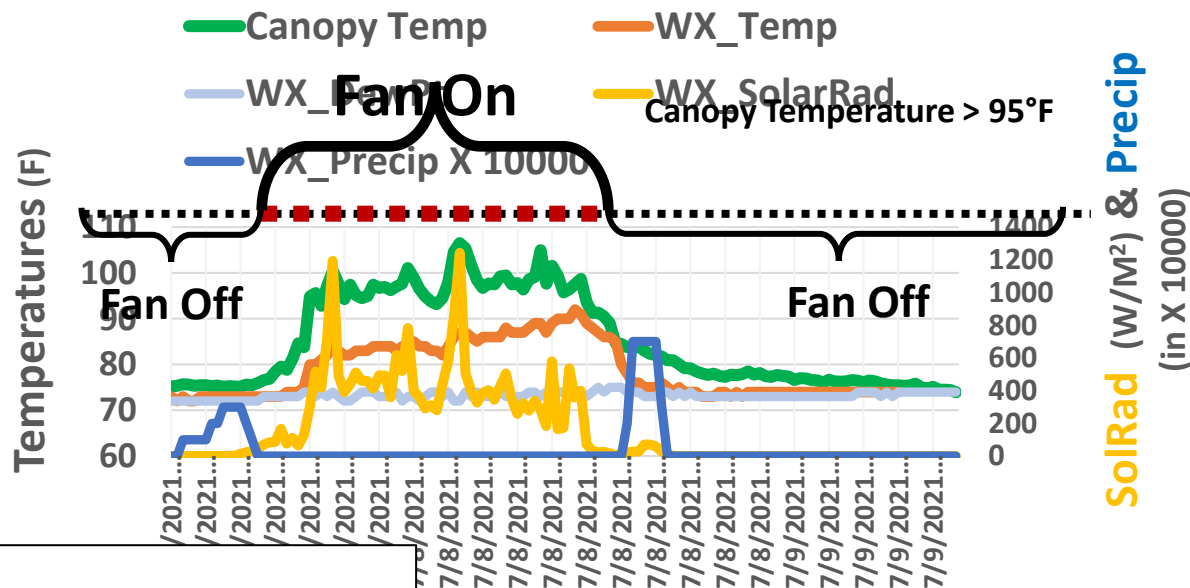


*These fans could be aimed better.
or Add a fan?*



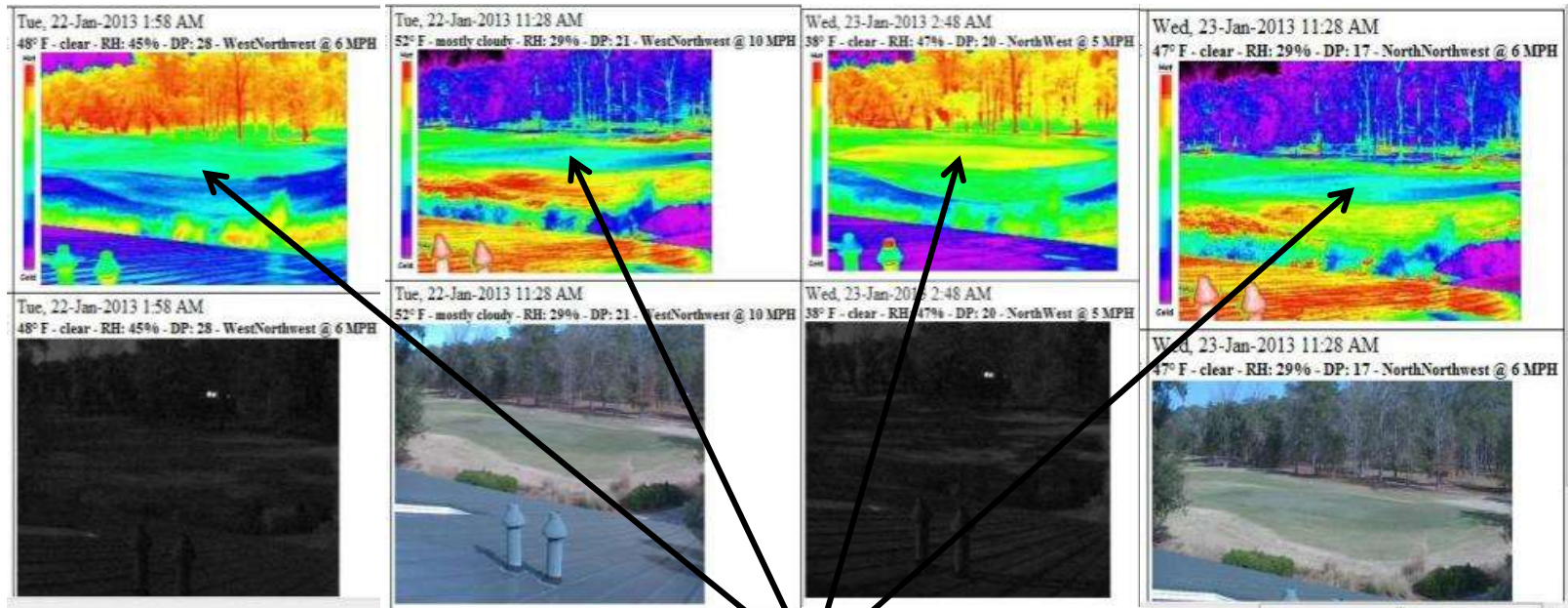
From: Hawk-Eye
To: e-mail and/or phone @ 1:25 PM
Nr03green Turn **FAN ON**
Turf Temp GTR 94 deg

When the Canopy Temperature is $> 95^{\circ}\text{F}$.



Only use Fans when needed.

Identifying Nematodes



Persistent Pattern

Cooler during night

Warmer during day

Getting Ahead of Winter Kill



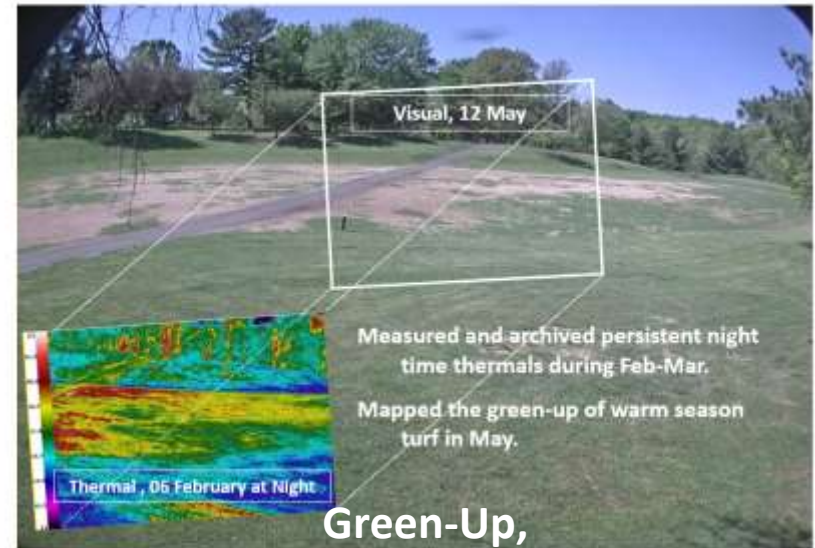
Locate Dead Spots to Remediate Early

Poor drainage.

Persistent wet areas.

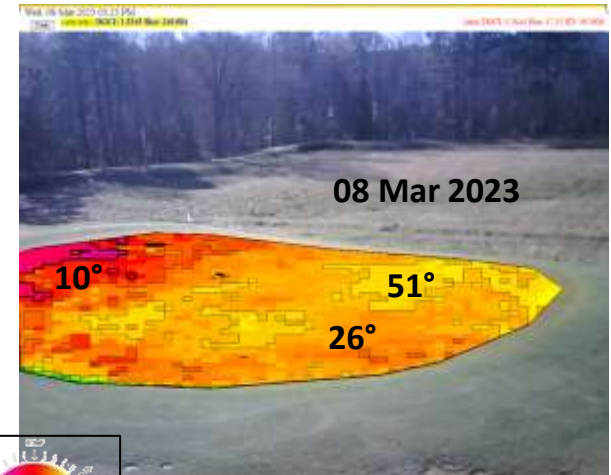
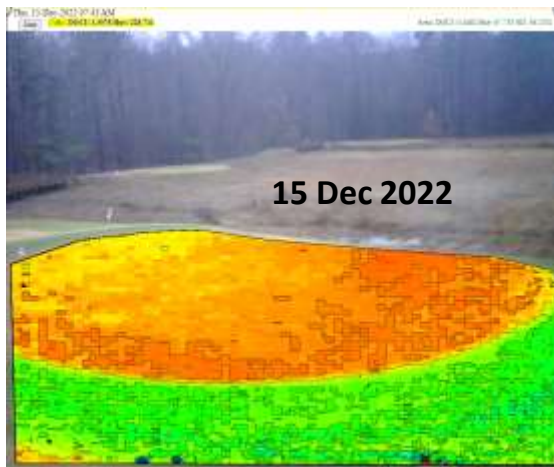
Persistently well below freezing temperatures
(more than 3 days in a row)

Frozen roots &/or crown = Winter Kill



The Movie: <https://vimeo.com/269639967>

Tracking and Understanding Green-Up



Slow Green-Up or Winter Kill ?

Not a severe winter.

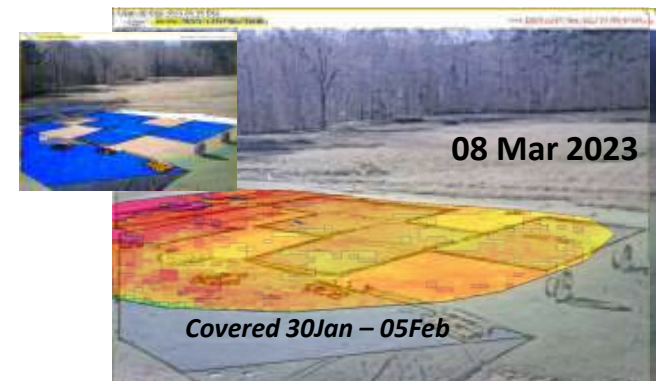
Christmas Freeze was only long period below 30°

Left side first into dormancy and first to green-up

Right side is shade and dry location

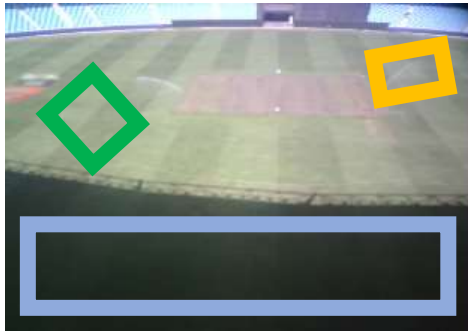
Driver for slow green-up (maybe kill?)

Also, for slower into dormancy

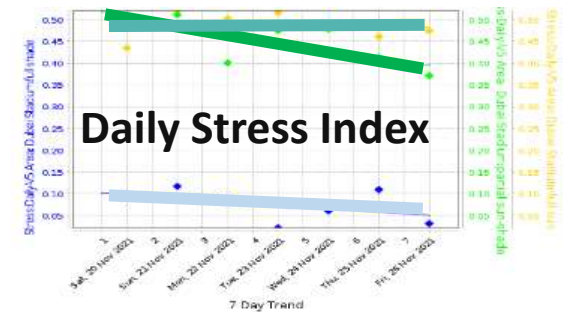
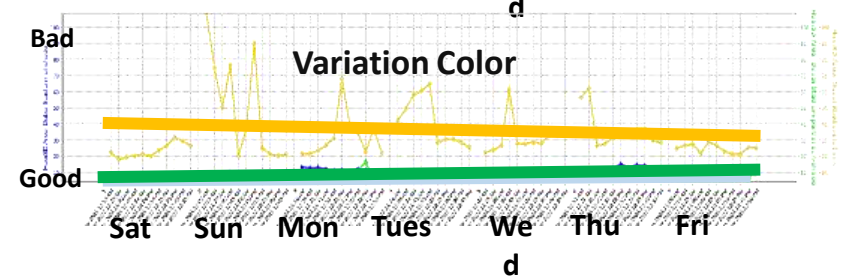
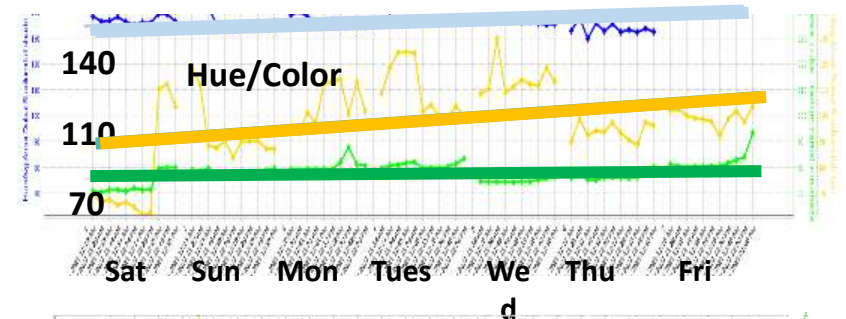


Measure the Impact of Shade on the Field

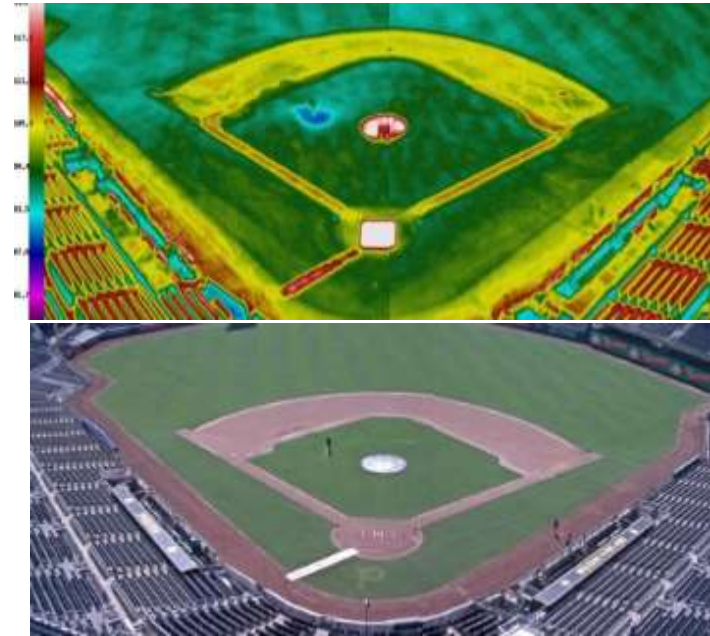
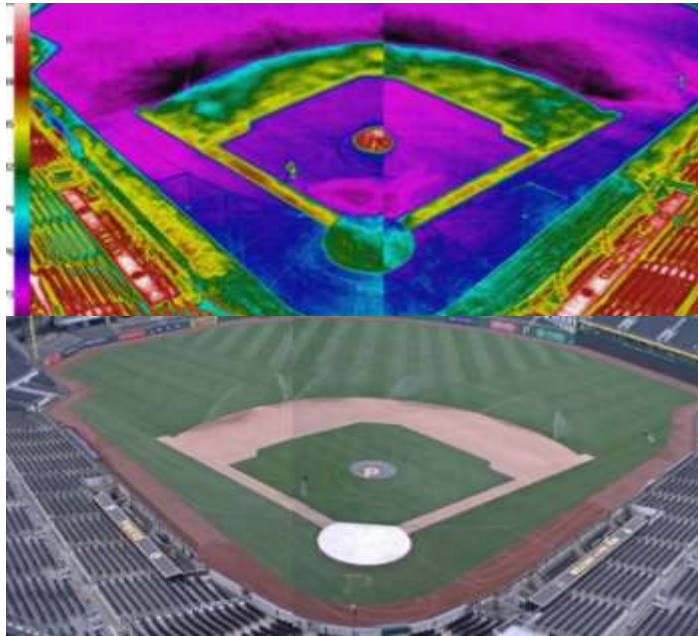
- Full Shade
- Partial Sun & Shade
- Full Sun



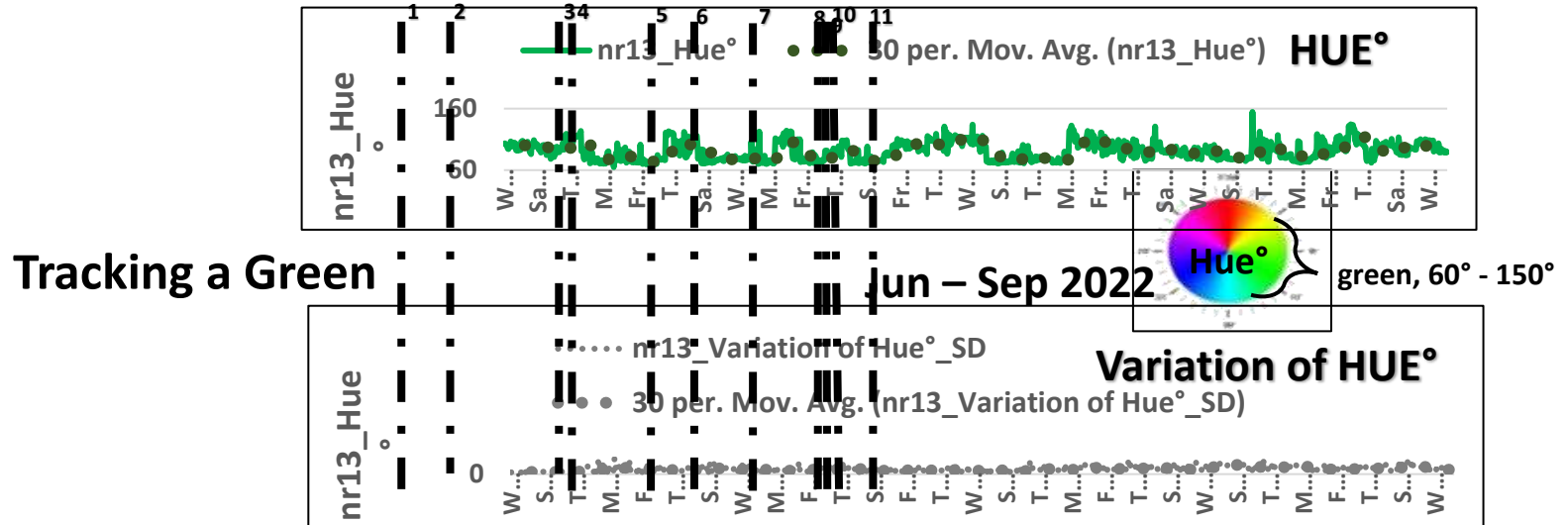
- Zone 1 too much shade – cut back in water
- Zone 2 ✓ - maintain $\approx .2''/\text{day}$
- Zone 3 full sun – add water & scarify in off season



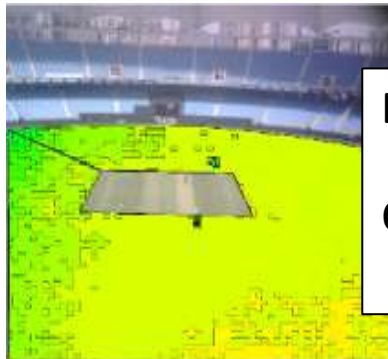
Monitor & Adjust Skin Uniformity



Guiding Fertility Applications



The Sport Field Talks



From: Hawk-Eye

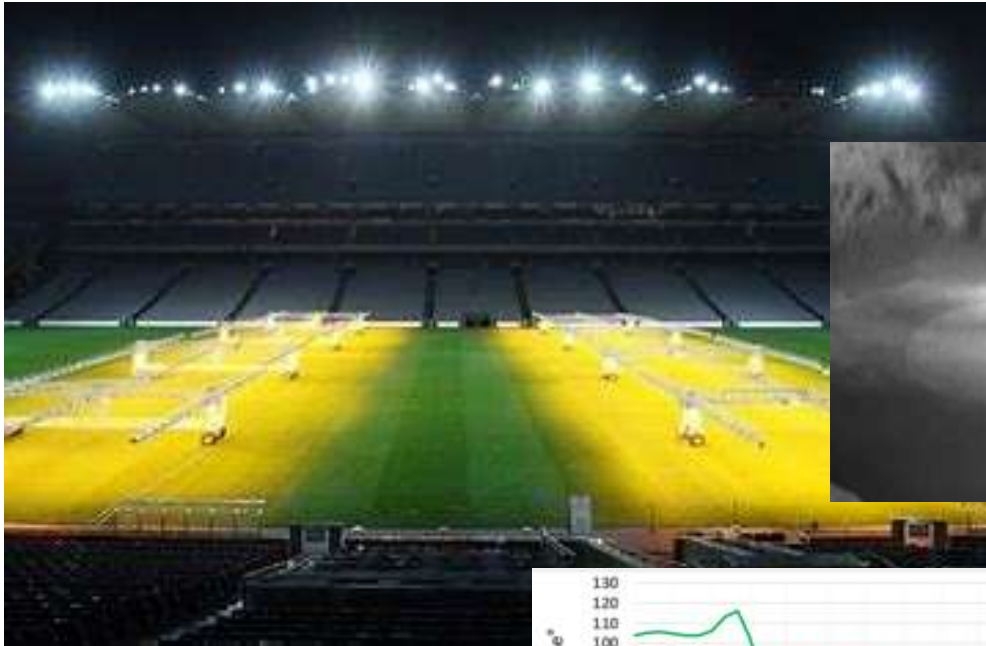
To: e-mail and/or phone @ 1:15 PM

Outfield SE Color is declining toward yellow

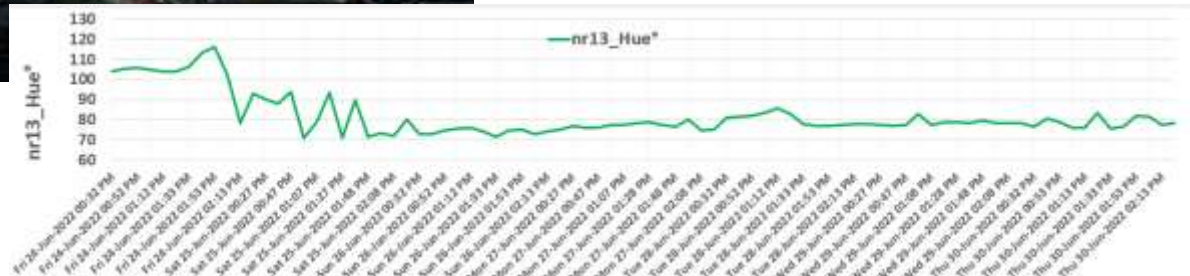
Test it

Grow Lighting

Why, When, Where ?



See it
Measure it
Manage it



Cost ?