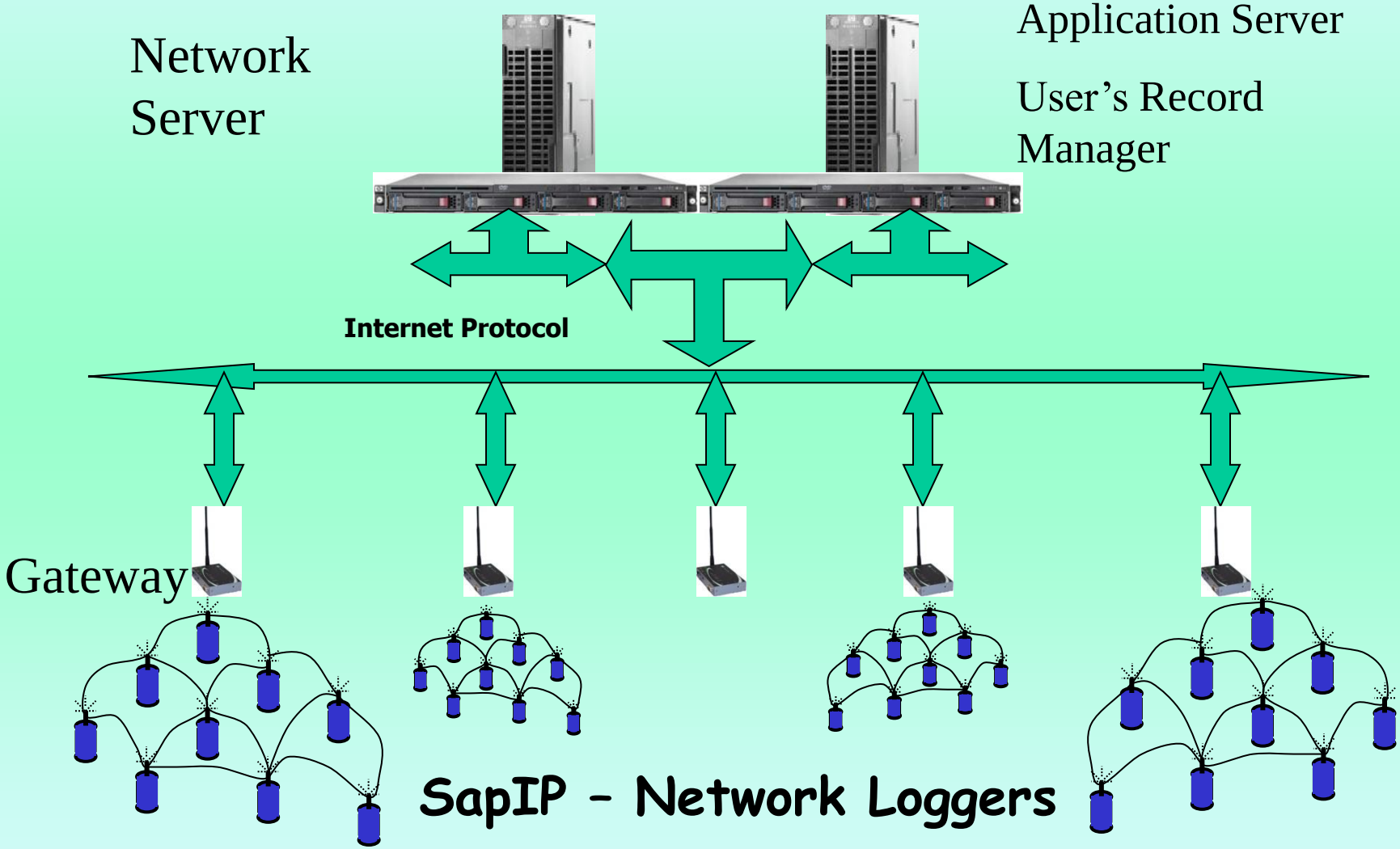
Dynamax

- Manufacturer of Flow32, FLGS-TDP, SapIP Wireless
  - Sap Flow Systems
  - Patented EXO-Skin sensors,
  - Dynagage Sap Flow Heat Balance
  - HPFM Conductance Meter, DEX Dendrometer
- Integrator of Weather Stations,
  - custom Weather Application

- Systems Integrator Agrisensors.net Cloud Based Data Manager

- A Primary Source for Plant Science Research Equipment

Agrisensors.NET
Remote Logging Network



SapIP System Features

Nodes:

- 30,000 Records
- 8 Analog In
- 2 Digital In
- Heater power
- Excitation

Gateway:

GSM or LAN Versions

Power 120 or 220 Volt

UPS battery backup

Solar – battery option

Easy Mounting

Comes Complete: Wiring, grounding, antenna, surge, mounting hardware provided

SapIP Nodes

Self Contained Nodes
Sap Flow or TDP

Micro Climate Kit

Weather Parameters, ET

Soil Moisture Node– up to 6 sensors

SPIP-IRT-AD

Leaf Temperature nodes up to 6 ea.

2.4 Ghz High Gain - 500 m Range

900 Mhz High Gain – 1000 m Range

SapIP REP Router

500 m hops to SapIP Nodes

Dynamax IRT Sensors

- Measure IR temperature +/- 0.5 C
- 20 degree Narrow Field of View (95%)
- Leaf temperature relates to plant stress
- Wireless or Analog versions
- Compare to CWSI or other Stress Model
- Excellent for use with drip or center pivot irrigation
- For use on crops where sap flow will not work, or on moving platforms

BASIC Data Collection

- ✓ IRT Sensors add Leaf Temperature and Leaf Stress Levels:
- ✓ High Stress = Temperature above ambient or non stressed plants
- ✓ Degrees Above Non Stressed (DANS)
- ✓ Possible when Sap flow data, plant water is not in use.
- ✓ Direct Addition to CWSI water stress.

3 BASIC Models - Retrieval

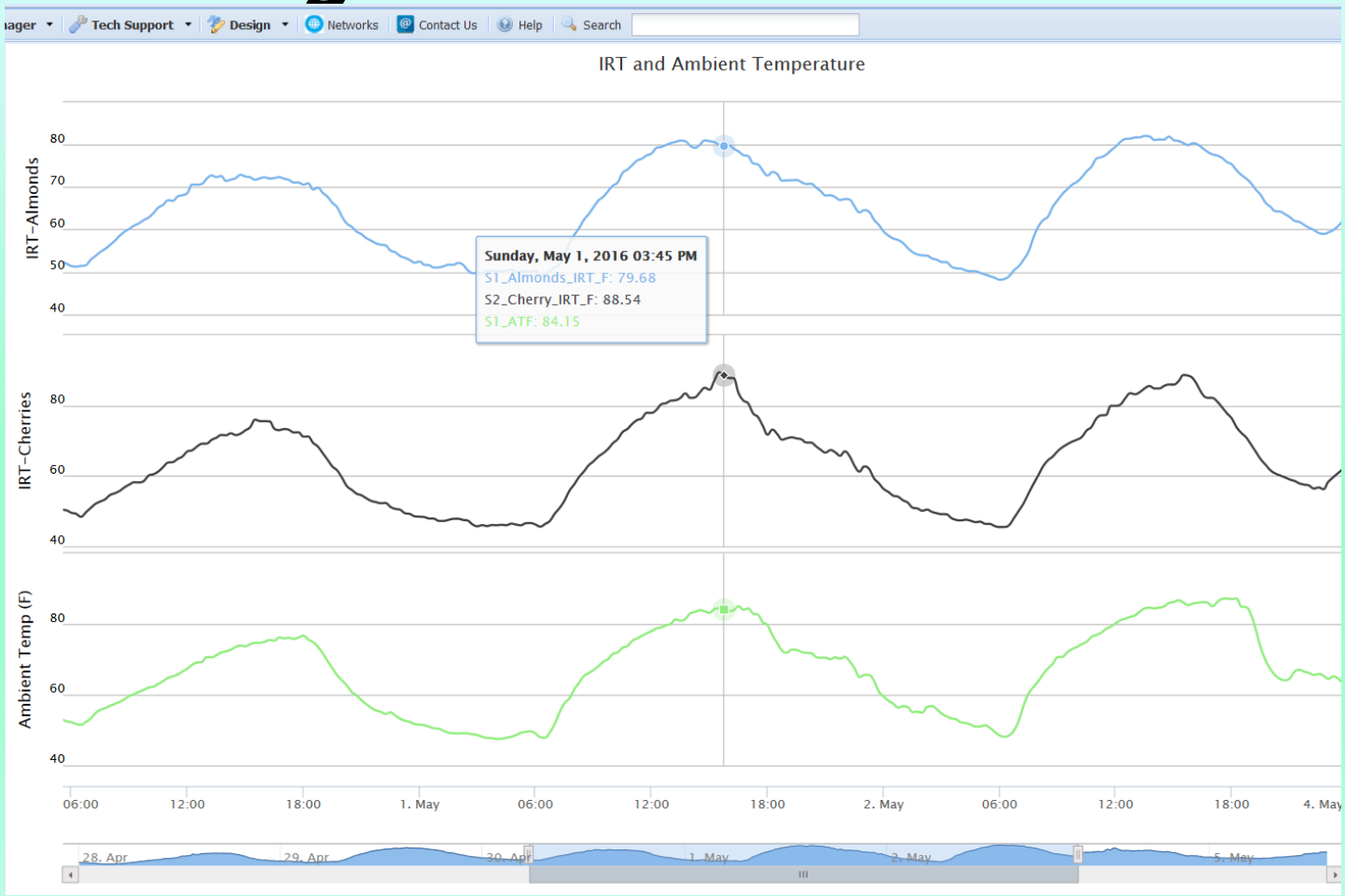
- 1) IRT Sensors (SPIP-IRT-AD)
  - Temp in Analog – For conventional signal loggers, two wire signal. (-40 to 160C = 0 to 1 V)
- 2) IRT- radio transmit Zigbee (SPIP-IRT)
  - Output=Ser no, Batt V, T-Target, T-body
  - Must obtain a Coordinator in Zigbee;
    - and a Router for every +9 nodes.
- 3) IRT – SDI12 transmit (SPIP-IRT-SDI)
  - Output=Ser no, Batt V, T-Target, T-body

IRT – IR Leaf Temp System

SPIP-IRT SapIP Wireless IR Leaf Temp Node

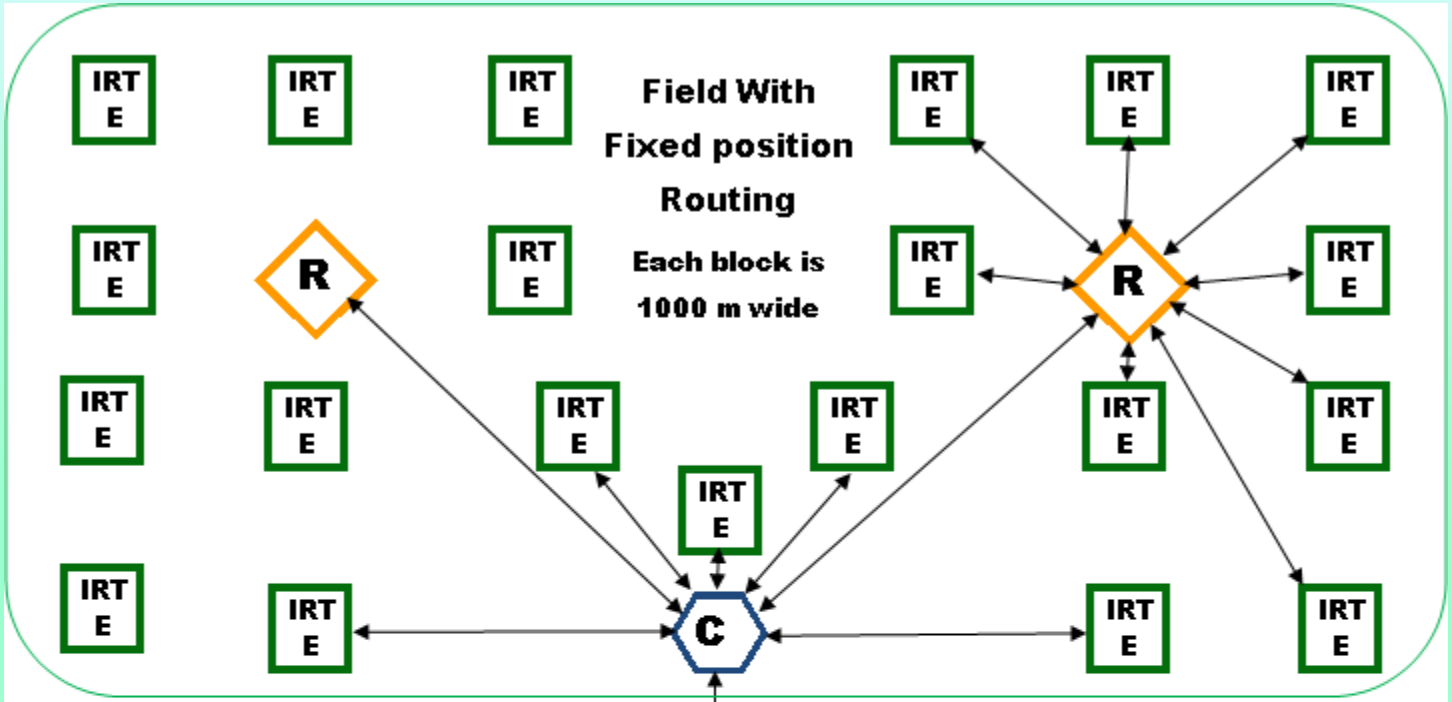
- Wireless IR Temperature
- Leaf temperature
- Plant stress measurement
- Irrigation scheduling
- For center pivot or other irrigation systems
- Uses low-cost Zigbee coordinators
- Developed with USDA-ARS

Agrisensors site data



Leaf Temperature for Cherries (Black)
is 4 degrees above ambient (Green) – Not well watered
Leaf Temperature for Almonds (Blue) is below ambient (Green) – well watered.

Field Data Collection



IRT E — Sensor End Device (Part: SPIP-IRT) 9 sensors per Router.

PC—USB Recorder
Win—IRT Watcher

Data Files, access for Analysis, and to inquire on IRT

C — Coordinator, which collects all data and streams to the USB port, to the PC. Each Coordinator may have (9) units of end device and (1) router. (Part: SPIP-IRT-COR. Each Coordinator uses longer range 5 dB antennas)

R — Router sending data to Coordinator. Takes the place of one end device on the coordinator list of 10 units. Has longer range antenna, and must be powered at all times.

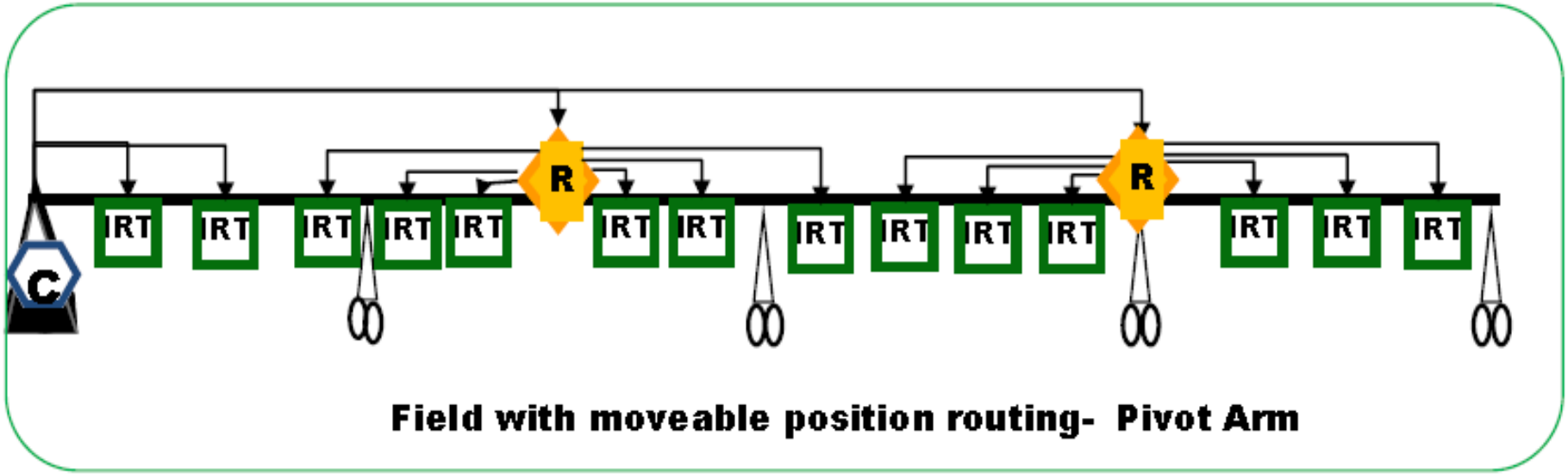
(Part : SPIP-REP24-ZB. Uses longer range 5 dB antennas.)

XBIB Coordinator

SPIP-IRT-COR
SapIP Coordinator Module Data Retrieval

- Coordinator connected to PC – USB, or Irrigation controller. Smart controllers have program changes based on temperature – CWSI algorithm.
- “IRT Watcher” Software collects files to PC
- Will handle up to (9) IRT Sensors for each (1) Router (IRT-REP-24ZB)
- 300 meter “Line of Sight” with outdoor antenna (IRT-ACC24-EW)
- Use Routers to add distance, 500- 600 m
- Up to (27) IRT possible with (3) Routers

Moveable – Irrigation Arm



	For PC Industrial and USB data Collection
SPIP-IRT	**SapIP Wireless IR Leaf Temp Node**
SPIP-IRTANT24	**2.4 GHz Antenna, Half Wave, 4"**
SPIP-IRT-COR	**IRT Coordinator Module**
SPIP-IRT-WS	**IRT Watcher Software**
SPIP-REP24-ZB	**SapIP Router Relay Module, 2.4 GHz**
SPIP-ACC24-EW	**External Waterproof Antenna Kit, 2.4 GHz**
6H5B	**Spare IRT Sensor Mount**
BA7A	**Rechargeable Battery, 12 Volt, 7 Ahr,**
MISC	**Mounting Bracket for 5W Solar Panel**
MSX10R	**Solar Panel, 10 Watts, Mounts & Regulator**
MSX5	**Solar Panel, 5 Watts, No Regulator**

Plant Stress Data Analysis - CWSI

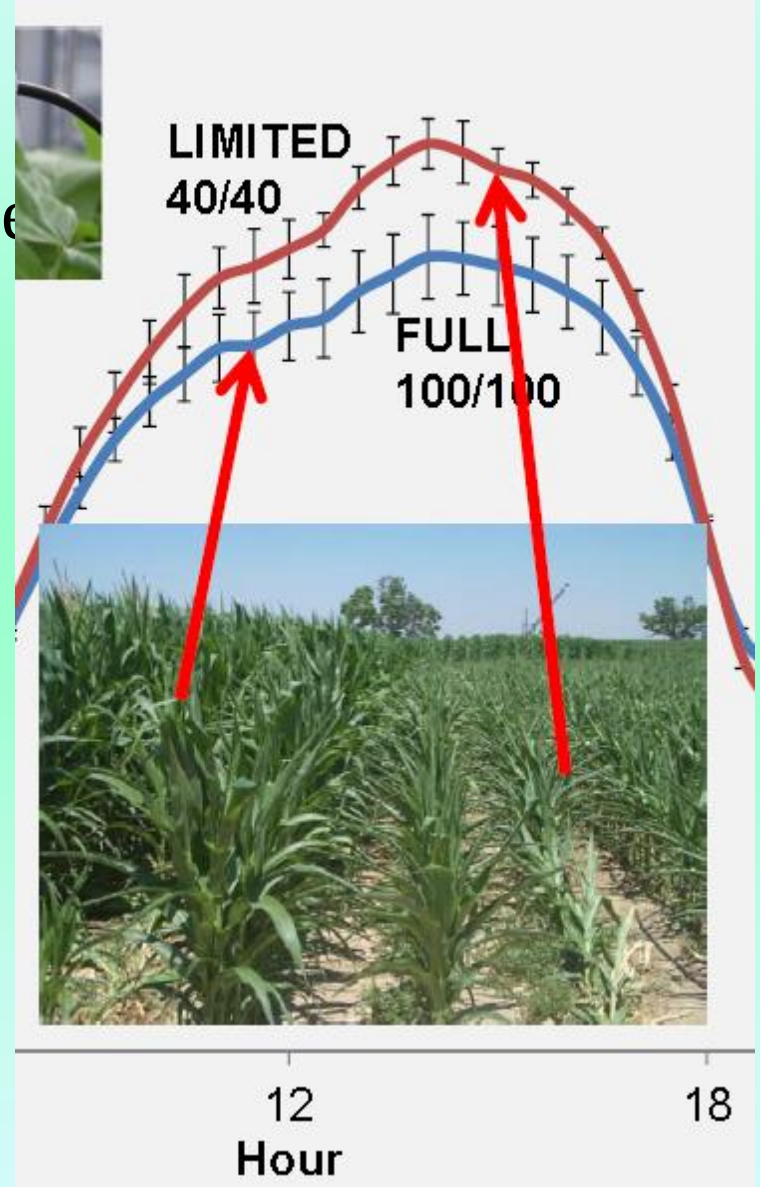
- CWSI = .4 to .6
- .5 = 50% reduction in water use

$$\mathrm{CWSI} = \frac{(\mathrm{d}T_{\mathrm{m}} - \mathrm{d}T_{\mathrm{LL}})}{(\mathrm{d}T_{\mathrm{UL}} - \mathrm{d}T_{\mathrm{LL}})}$$

- $\mathrm{dT}_{\mathrm{UL}}$- Upper limit
- $\mathrm{dT}_{\mathrm{LL}}$ – Lower limit

$$\mathrm{d}T_{\mathrm{LL}} = m \times \mathrm{VPD} + b$$

$$\mathrm{d}T_{\mathrm{UL}} = m \times \mathrm{VPG} + b$$



Simple Data Presentation

Plant leaf temperature vs :

$$\mathrm{CWSI} = \frac{(\mathrm{d}T_{\mathrm{m}} - \mathrm{d}T_{\mathrm{LL}})}{(\mathrm{d}T_{\mathrm{UL}} - \mathrm{d}T_{\mathrm{LL}})}$$

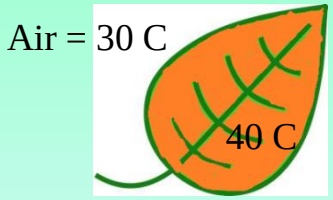
$dT_m = \mathrm{Max}\ (T - T_{air})$

1) Total water stress CWSI

CWSI =1- Ea / Ep = Actual Transp. / Transp Potential

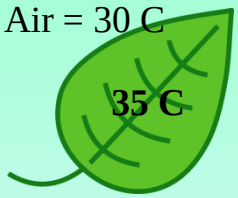
Growers need only decide how much CWSI can be tolerated before irrigating (.4 to .6)

Water can be conserved if irrigation schedule is reduced, and Stress Factor remains neutral.



$$\mathrm{CWSI} = \frac{(40-30)\mathrm{C} - (35-30)\ \mathrm{C}}{(45-30)\ \mathrm{C} - (35-30)\ \mathrm{C})} = .50$$

Medium Stress depending on plant.



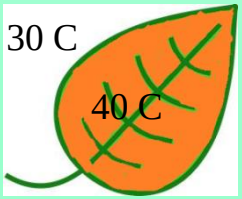
CWSI =0.0

No Stress

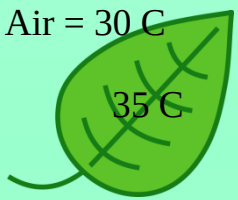
(T_{LL}=5 C)

2) DANS = Degrees Above Non Stressed plants.

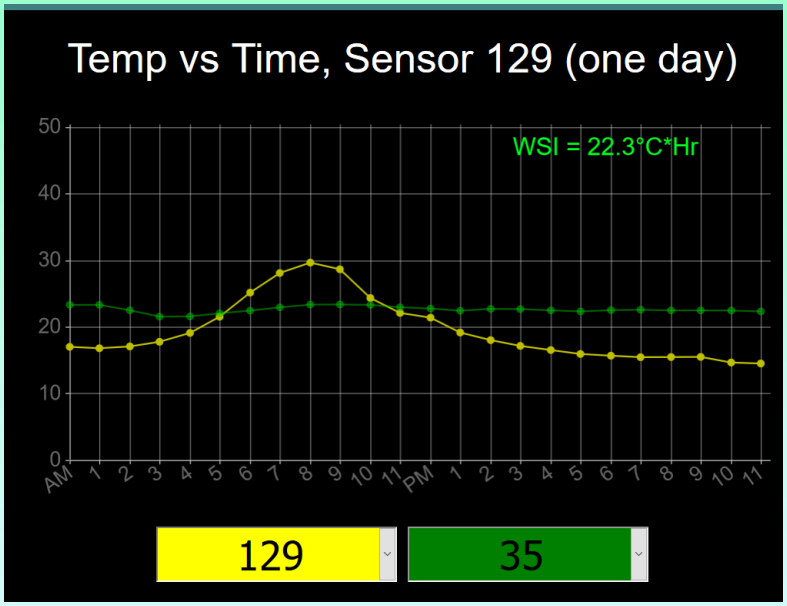
Stress Factor = higher temperature above well watered plant (Degree-Hours)



DANS = 5.0 C

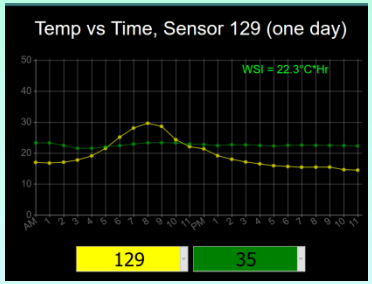


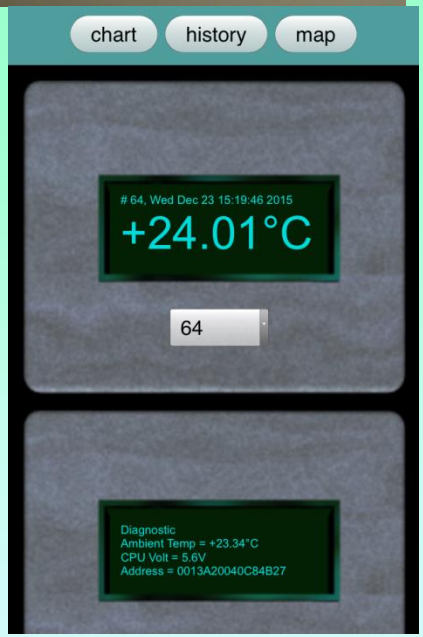
iDANS =
Integrated
Degrees Above
Non Stressed plants
(Show here as WSI= 22.3 C)



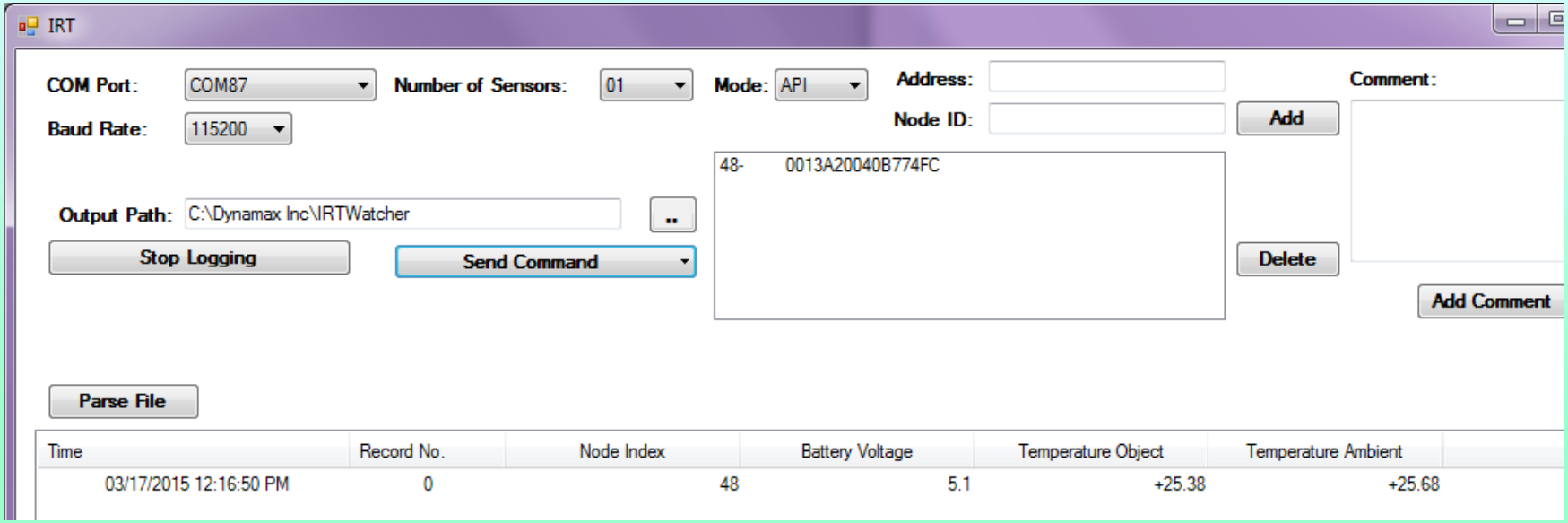
IRT-SALH Data Loggers

- Monitors up to (25) IRT /(3) Router
- Stress Accumulator Software (SAL)
- ZB Link Receiver – WIFI Transmit
- Memory for 65,000 records
- SD Card Slot for Data (1 M record)
- WiFi for data collection, 20-50 ft range
- Webpage data access, Mapping for locations
- iDANS and temp is transmitted to Mobile phone (WEB Page)





IRT Watcher



- Install on PC or Industrial control PC with Windows
- Set up communications with USB to coordinator
- Retrieve records for each IRT node within distance
- Save all data into .csv files for excel, attaching date and time.
- Can do setup and network commands, such as "Test" command, and Network reset.

Thanks for having us!

Any questions?