

SmartCrop[®]
Listen to Your Crop

BY:
Smartfield[™]
INTELLIGENT RESOURCE MANAGEMENT TECHNOLOGY

LUBBOCK, TEXAS USA
WWW.SMARTFIELD.COM



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DESCRIPTION

SmartCrop® is a revolutionary irrigation management system that uses the plant itself as the sensor. Therefore, we say, "Listen to Your Crop." SmartCrop® reads the canopy temperature of the plants every minute of every day, and then uses this temperature information to determine if the plant is experiencing water stress.

How does it know? Once SmartCrop® is installed, the system is setup on our website (www.smartfield.com/data). On the website, the user inputs information about the crop. Included in this information is the optimum canopy temperature for the specific crop (we call this the Stress Temperature). This optimum temperature is determined in a plant sciences lab. Basically, the researcher measures the activity of certain enzymes over various temperatures and this lets us know at what temperature the plant grows best.

The actual canopy temperature is then compared to the known optimum temperature and it is determined if the plant is experiencing any heat stress. Other measurements are taken to determine if the plant can be cooled with irrigation. If so, an "irrigate" signal is sent to the grower.

INSTALLATION

The SmartCrop® system is relatively easy to install. The installation includes positioning the Sensors in the field, positioning and connecting the Base Station (usually near the irrigation control panel), placement of the antennas (the cell phone antenna and the antenna for the Field Sensors), connection of the other sensors to the Base Station, and the power-up process.

SENSOR INSTALLATION

Before placing the Sensors in the field, the batteries should be installed. Disconnect the end of the Field Sensor assembly from the tube with a short counter-clockwise turn. Take out the Field Sensor assembly and locate the two battery boxes on the circuit board. Install 4 AAA batteries making certain that the batteries are installed correctly (the negative end of the battery will contact the coil spring in the battery well.) As soon as the batteries are installed, the light will blink at the end of the assembly. Reinstall the Field Sensor assembly into the tube. Once the batteries are installed, the Sensors will begin running. The light at the end of the tube will blink occasionally as the Sensor takes environmental readings.

FCC NOTICE

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
- It is strongly recommended that the TV be plugged into a separate wall outlet.

This equipment has been verified to comply with the limits for a class B computing device, pursuant to FCC Rules. In order to maintain compliance with FCC regulations, shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio and TV reception. The user is cautioned that changes and modifications made to the equipment without the approval of manufacturer could void the user's authority to operate this equipment.

MORE ON ANTENNA PLACEMENT

Antenna placement is extremely critical for maximum performance from the SmartCrop® system. The Field Sensor antenna collects data from the sensors in the field. It should be placed so that there are no obstructions between the antenna and the Sensors. Caution should be taken to assure that the metal structure of the center pivot base is not inhibiting the performance of the radio. The system antenna should be placed at least five feet off the ground using the supplied Antenna Arm as shown in figure 3. If for some reason the system antenna cannot be placed on the center pivot structure, then it can be located near the Base Controller in a manner that allows the antenna to be at least five feet off the ground with a clear line of sight to the Sensors. The Antenna Arm is designed to locate the system antenna an appropriate distance from the center pivot tower such that the pivot tower becomes part of the system antenna thereby maximizing the performance of the antenna. Sensors with distances of up to 1,000 feet are achievable with correct antenna placement. If a cell phone modem is part of the system as well, its placement is also critical to the performance of the system.

SYSTEM START-UP

All connections should be checked one more time and then power should be applied to the Base Station. This is done by first connecting the on-board battery of the Base Station. The Base Station is shipped with one of these battery connections not connected. As soon as the battery is connected, power can be applied to the Base Station from the two external power sources supplying 12VDC input.

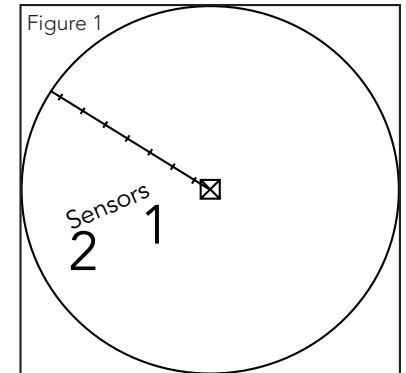
As soon as power is applied to the Base Station the system will begin operating. It may take up to 15 minutes for all Field Sensors to report. The Cell Modem may take up to one hour to establish a connection with the local cell phone tower.

WARRANTY

Smartfield, Inc. warrants the SmartCrop® product for one year from purchase date. Please see the included warranty for details.

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Once the Sensors are operating, they should be installed in the field. Sensor location in the field is a very critical step to insure that you receive useful information regarding the water status of your crop. If used with a center pivot, the Sensors should be located in a straight line proceeding radially from the base of the center pivot to the edge of the field (see Figure 1). The closest Sensor should be 100-300 feet away from the center of the field and the furthest Sensor should be 600-1000 feet away from the center of the field. Additional Sensors can be placed between the Sensors at the two extremes. If used in a field that uses a drip system or is gravity watered, the sensor placement should be determined based on how the information will be used. For instance, if various sections of the field can be watered independently from each other, the additional Field Sensors may be used to obtain a more precise measurement of water stress in the various sections of the field. Up to 16 Field Sensors can be used in one system.



The Field Sensor should be placed such that it looks downward at the crop canopy. Please note the "LEVEL" line on the Field Sensor tube and install the Field Sensor so that the "LEVEL" line is level with the ground. The sensor in the end of the Field Sensor tube should be 1-2 feet above the canopy. The sensor sees a spot on the canopy with a diameter equal to the distance it is above the canopy. Take care to arrange the Sensor so that it only sees the crop canopy and not soil. As the canopy develops, this will be less of an issue.

The top end of the Sensor contains the transmitter antenna and it should have a clear view of the of the system antenna at the Base Controller. If a metal fence post is used to support the Sensor, the fence post should be placed on the side of the Sensor away from the Base Controller. (See Figure 2)



BASE STATION INSTALLATION

The Base Station is generally located near the irrigation control panel. The Base Station is powered by two incoming 12VDC power sources. These two separate power sources are used to determine when power is applied to the irrigation system. Therefore, one power source should provide power only when the irrigation system is running. This power source is considered the MAIN power and should be connected as such. The other power source should provide power continuously and should be connected as the AUXILLARY power. Do not connect power until all other connections are made and antennas have been installed.

Find a suitable location for the Base Station and mount it. If it is mounted on the front of a metal electrical panel, the magnets and bracket on the back of the Base Station can be used to secure it to the panel door.

Once the Base Station is placed in the correct location, proceed with the following installation steps:

RH POD INSTALLATION

The RH Pod should be located within 8-10 feet of the Base Station in an area of the field that is similar to the crop environment. If the RH Pod is located too close to any concrete or bare area of the field, the local ambient temperature in such an area will be higher than the ambient temperature in the field. This temperature difference will not provide an accurate picture of the field condition and should be avoided.

The RH Pod should be mounted on a metal fence post similar to that used with the Field Sensor. It should be located above the crop canopy, at a height of at least 4 feet above the ground.

The RH Pod is supplied with a cable that is similar to a phone cable. This cable plugs into the RH Pod on the bottom side. The other end of the cable connects to the circuit board of the Base Station. The cable should be fastened to the RH Pod bracket to provide protection for the cable.

RAIN GAUGE INSTALLATION

The rain gauge comes installed on the rain gauge bracket. This bracket is designed to be installed either onto the pivot tower or onto another structure in the field. The surface of the bracket where the rain gauge sits must be level for the rain gauge to work correctly. Once the rain gauge bracket is mounted, use a small level to assure that the bracket is level. The rain gauge should be approximately 6 to 8 feet above the ground.

The rain gauge has a cable that should be fastened to the bracket and to various locations along its path to the Base Station so that the cable is protected. The cable connects to the bottom of the Base Station circuit board.

FIELD SENSOR ANTENNA INSTALLATION

The Field Sensor antenna has a magnetic base. It must have a clear line of sight to the Field Sensors. Ideally it should be located on the rain gauge bracket, but it can be located on any metal surface that is the correct height off the ground. The less optimum the placement of the Field Sensor antenna, the less range the Field Sensors will have. If the Base Station is not receiving a signal from some of the Field Sensors, relocating the Field Sensor antenna to a more optimum location is the best approach to improve range.

The Field Sensor antenna connects to a small circuit board near the top right corner of the Base Station.

CELL MODEM ANTENNA INSTALLATION

The Cell Modem antenna also has a magnetic mount. Care must be taken that the antennas are connected to the proper locations in the Base Station. The system will not be harmed by incorrect connection, but the system will not work if the antennas are connected backwards. Place the Cell Modem antenna on a section of metal, but DO NOT place it on the rain gauge bracket if the Field Sensor antenna has already been mounted there. If you know where the closest cell phone tower is, place the antenna in a location that will provide the best line of sight path with no metal structures in the way. The cell phone antenna should be placed on top of a local structure, with the antenna pointing vertical. It should NOT be located between the Sensors and the system antenna. It should be placed away from the system antenna by a minimum distance of five feet. If the Base Station is not receiving transmissions from the Sensors, the cellular modem antenna should be disconnected for a one hour. If the Sensor transmissions are received by the Base Station then the cellular antenna should be relocated further away from the system antenna and then reconnected.

RAINALERT CONNECTION INSTALLATION

If a RainAlert product was provided with your system, please see the instructions that came with the RainAlert product for installation to the irrigation system. When used with a SmartCrop® system, the Hunter Mini-Klik rain switch is replaced with a connection to the SmartCrop® Base Station. The Base Station uses information from the rain gauge to determine when to send a signal to the RainAlert.