Engineering a Solar Heated Temperature Preservation Tank for Low Cost Citrus Protection

Hecker, Blair (School: Fowler High School)
Dhanda, Manjot (School: Fowler High School)

A massive drop in bearing acres is attributed to severe damage to the trees caused by freezing temperatures. A new freeze prevention method was created through incorporating a solar energy retention insulation device. The device is able to reduce the effect of freeze on citrus orchards once a critical freezing ambient temperature is reached (-1.8°C to -2.8°C, dependent on citrus variety) through increasing irrigation water temperatures. The design approach taken was insulating an all-black tank that will absorb energy during the day from the sun while heating the water inside. When the critical freezing temperature is reached farmers can then pump water that is warmer than the normally used “ditch water”, through their current irrigation system and when the water is dispersed underneath the trees, heat will rise and the tree/fruit will be warmed. The experiment was carried out on two identical water tanks, one treated with matte black paint and one remained the bare white plastic, that had been placed out in the sun to be solarly heated during consecutive days with night time freezing temperatures. At dusk (5:30 PM), this device was applied and insulated the tank to preserve the heat that had been absorbed during the day. Data was accumulated through the wireless thermometer which would take readings every five minutes, accumulating 288 data points per day of testing. The water inside of the black tank reached a daytime temperature significantly above both the ambient and the identical white tank’s temperatures (approximately 15°C warmer). At night, with the insulation device, temperatures of at least 20°C above the ambient temperature was sustained. The method not only saves money but also has the ability to save jobs, liability, and overall productivity of citrus.

Awards Won: