



Greenhouses

Transcript – Heating

Hello and welcome to Honor's Lab, Greenhouse Construction. This is module five. So, in this module, we're going to talk about the different ways to heat your greenhouse. There's several different climates on this planet and we all have a little bit different heating needs. Some of you may not need to heat your greenhouse, but some of you definitely will. So, the goal of our heat system would be to keep the plants from dying, so the warm weather plants need to stay above 32 degrees and the cool weather plants will need to stay above 25 degrees to prevent any damage. The first question that we need to ask our self is do we want to grow year-round? If you're wanting just to have a three-season greenhouse, then you will not need to heat the greenhouse. Also, if you're growing cold-weather plants and your location is zone four or higher, you will not need to heat for the winter and if you're growing warm-weather plants or tropical plants, you will need to heat in zone seven and lower. So, the cold weather plants will be able to take a frost down to 25 degrees and the warm weather plants will not take a frost at all.

So we grow year-round and I have four greenhouses with heat systems and I have one greenhouse with no heat system and we grow only cold weather plants in the winter, but the heat system does help them to grow better. So first let me show you how you would grow cold weather plants in zone four and higher in your greenhouse without any heaters. Okay, so let's say we're in your greenhouse and this bed of lettuce you're wanting to protect from the frost. So what we do is we put on some kind of -- these are just a wire or anything that's going to keep the cloth up off the plants and then we put on -- this is a heavy frost blanket. It's really thick. You can use towels, you can use double sheets; anything that's going to insulate a little bit and we just put this on for the night and what this will do is this will keep the plants from going too cold. This system inside a greenhouse is good down to probably 10 degrees Fahrenheit. So, if it's 10 degrees outside, you're in your greenhouse and you put this cover on, you should not get any frost down inside your plants. It will depend a little bit on your location and stuff, but this is a really great way to just protect the plants without having to buy a heat system for your greenhouse. So, if you're in a fairly mild climate, you can do this. If it's going to be below 10 below, I actually put on a second layer. It works really good even with a second layer. I bet you could take the plants down to zero. You'll have to figure out in your greenhouse exactly what you can do, but this works really, really good.

You can take the plants a really long ways from frost damage just by using some wires and some covers inside your greenhouses, but if you're wanting the plants to grow a little bit faster or you're wanting to start your warm-weather plants early in the spring or take some warm weather plants through the winter, then a heat system's gonna be really nice. I'd like to show you the heat system we have and how we use them. All right we're here in the tomato house and the heat system for this building is like an in-floor water heat system that you would have in your house and basically how it works is we have a domestic water heater just like you have in your house. It's set at 90 degrees. It's on a closed loop with our five grow beds, so the way it works is we have a thermostat here that measures the temperature of the soil. When the soil temperature drops below 60 degrees, it tells the water heater to turn on and the water heater circulates the 90-degree water. So, the water comes in on this tube and the tubing is actually this plastic tubing here. This is just an insulative cover because the building is usually kind of cold and the water goes in here and the tube goes all the way to the end of the bed and then turns around and comes back here. And then this is the pipe going back and this goes back to the water heater. The water gets reheated and then comes back again.

So as long as the soil is below 60 degrees, the water is continually circulating through here. This white pipe here -- this is just an irrigation system. It has nothing to do with the heating and it's up on top. These tubes are actually in the bottom of the bed heating the soil from the bottom up. So, the water just circulates just like an in-floor heat system in your house and then this wire here holds our covers. We have white covers that cover the bed, so basically, we're just heating

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a section that's only this tall. The rest of the building can get as cold as it wants and this is some just really, really good -- we've had 10-12 below outside and the plants inside are just fine. Once in a while, they'll get a little nip on the edges of frost, but we just let them thaw out and then they're ready to pick and go. And we grow all cold-weather plants, mostly lettuce in here through the wintertime.

All right, we're here in the solar house and I want to explain this heat system to you. So basically, we're standing in a solar collector and even in January when it's super, super cold out, it'll still have warmth as collected up here in the ceiling. So, if you look up, you can see that there's black pipes up there. That's the intake for the hot air, so when it's 60 degrees at chest high, the thermostat comes on and it pulls the hot air through the pipe and down to -- there's a squirrel cage fan in the corner there. Then from the fan, the air is distributed -- each fan does two beds. So, it pushes the hot air down into the bed and these two lower layers here, these are full of gravel and that's where we store the heat that comes in. This is a vent pipe that lets the cold air come out. So the heat gets pushed in, vents here; this layer here is where the soil is, so the heat radiates up from the gravel into the soil and then at night, we put on our heavy blankets at night and what we have found out is that we gain about 13 degrees of temperature in the soil during the day and then that heats the plants at night. So, it can be -- we've had as cold as 13 below outside and we've had no frost inside under the covers. So, the plants, they do really, really well in this system. So, they get heated from the bottom. We're holding the heat in with the blankets. If it's gonna get colder than that, I can put on a second blanket just to help insulate a little bit better.

All right, we're here in the big house and I'll show you this heat system. We used to have two great big propane heaters in here and we've since sold those off. It is so nice not to have them and to pay the propane bill. So, what we have going on here is outside in the parking lot, the parking lot's on the other side of this wall here, we have 168 feet of 6-inch plastic pipe; it's a corrugated pipe. And it is buried five feet deep out in the parking lot, and it is just coiled out there in the parking lot. So basically, it is -- well, how it works is that we have an intake outside. So, we take outside air, we take it down into the earth, it circulates through the coils and then it comes up through here in the wintertime. Our thermostat is set at 45 degrees, so when this building drops below 45 degrees, this fan turns on and it's pulling the air through the system that's out in the parking lot and blows that air into here. And I know 45 degrees doesn't sound like a lot, but it's huge. It changed the entire dynamic of this building. We were number one, able to get rid of the propane tanks which was fantastic, no more propane heaters. And number two, it kept the soil from freezing in my grow beds, so I can grow in this building with no supplementary fossil fuels and my soil doesn't freeze so I can grow year-round in here with all my grow beds and it's really, really amazing. I don't even have to put any secondary covers on because we don't freeze in here and works really, really well.

Here we are in our little greenhouse. This is a pit greenhouse. It's about 800 square feet and ground level is right here. So, you can see we're about three feet down into the ground. So, the whole outside of the greenhouse is insulated. We got a lot of mass in here and we also are down in the earth and that helps to warm us. All right, the rest of the heat system for the little greenhouse is this rammed earth wall. It's 16 inches thick. It's just rammed earth from our grounds here and then it has the cement pillars for stabilization. This wall's been here about 30 years. It does a great job. So, what we get in here is temperatures in the wintertime, we can be zero degrees outside, we're still hovering right around 32-35 degrees inside. When I have warm weather plants in here, I will put a cover over those just in case, but we haven't had any frost in here. This building works really, really well; no other heat systems in this building.

All right, so those are the heat systems that we are currently using in our greenhouses. So, here's a few other types of heat systems that you might want to investigate for your greenhouse. So electric heaters. You can use very small electric heaters to keep your plants from freezing on the coldest nights. You can heat the whole greenhouse or I've put the small -- the little ceramic electric heaters under the covers in my low tunnels that had warm weather plants inside them and it's done really, really well, but do it at your own risk. You need to be sure that you can't catch your blankets on fire, and it is -- it's a little sketchy, so pay attention to what you're doing. And this is really expensive heat, so you probably won't want to run it every night.

The next one is the rocket mass heater. This is a heat system that we're currently looking into installing. So, these are super-efficient wood-burning stoves that has a thermal mass built into the exhaust system to capture all the heat. So, they've been used in greenhouses successfully to keep the greenhouses warm. All right, next is the propane or the natural gas heaters and when we first put in our greenhouses, we had greenhouse propane heaters. That's what the commercial growers typically do. It was very, very expensive to run and one night, the heater didn't light, and all the plants froze. So, it only took one night to totally wreck a whole season's worth of growing. We still have one heater left; it's in the tomato house and the birds have a nest in it. So, we just let the birds nest in it. We don't use it anymore.

The next is a wood boiler. This is a system that burns wood to make hot water that would flow through the soil or the floor of the greenhouse. So, I think this would be a really great way to heat a greenhouse. It would be very similar to the heat system that we have in the tomato house like the in-floor heat system with the hot water except it would use the wood to make the hot water instead of us using the electric water heater. The next heat system you could look into is called a climate battery. So, a climate battery, otherwise known as a subterranean heating and cooling system. This is a great system. It takes the warm air from the heat of the day and stores the heat calories in the floor of the greenhouse to radiate back out at night. This is similar to the solar house design except the heat is stored in the floor 12 inches in deeper under the greenhouse and then the soil is there -- the 12 inches of soil is for you to plant directly in.

Okay, the next one is compost heaters and it's possible to heat your greenhouse from the waste heat given off by a compost pile. This method is not readily used because of the volume of compost needed to make enough heat to heat a greenhouse. So, what the Golden Hoof Farm in Boulder, Colorado, they have a 12-foot round pile of compost to heat a 300 square foot greenhouse. So, you gotta think about the size of the pile and the size of the greenhouse. So, the way it works, typically plastic tubes are placed in the center of the compost pile and the water is circulated through the plastic tubes to collect the heat and that transfers to the greenhouse. And usually, it goes into the soil of the greenhouse. So, you're transferring the heat from the compost pile to the greenhouse via water underground. So, if this has piqued your interest and have access to a lot of compost material, then this might be the perfect heat system for your greenhouse.

The next one is a passive thermal mass heat collectors. This is the oldest and simplest way to save the heat generated by your greenhouse during the day and use it for heating during the night. So, this helps with the temperature swings inside the greenhouse. So, we have two passive thermal mass systems in our greenhouses. We have one in the big greenhouse; we have a 12-inch-thick cement wall that's about eight feet tall along the back of our greenhouse and then in the little greenhouse, we have the rammed earth wall. Those are both passive thermal mass systems in our greenhouses. So, the mass helps to keep the greenhouse cooler during the hot days and warmer during the cool nights. Barrels of water are the best for storing heat units, so they work even better than the rammed earth and the cement. So, you can use two to five gallons of water per square foot of greenhouse glazing if you're going to rely on this method exclusively.

The next one is animal heaters. So, in the Sylvida greenhouse, she uses animals like chickens and rabbits to provide heat for the plants. So, Anna claims that one pound of animal can give off eight BTU's of heat per hour. If you have 400 chickens and 100 rabbits, they could give off 432,000 BTU's of heat per 24 hours. So, this is enough heat for a 10,000 square foot greenhouse; that's incredible. So this is a really great concept to work with and I'm definitely gonna have to try this because we have a lot of laying hens.

So, there's many ways to heat your greenhouse without using a lot of fossil fuels. So, for your homework, I want you to investigate three possible heat systems that you think might work for your heating needs. This is the end of module five and in module six we're going to learn about vents and cooling systems.