



Dallas Flynn's solar panel-heated greenhouse uses 3 adjacent solar panels to warm up the soil.



Greenhouse floor is covered with 1 ft. of sand and a series of 4-in. corrugated drain tile on 16-in. centers.

By Jim Ruen, Contributing Editor

## Solar-Heated Greenhouse Makes “Exotic” Fruits Possible In Minnesota

Dallas Flynn beats the competition at his northern Minnesota farmer's market by two months with ripe tomatoes in June and fresh-picked tomatoes in November. He has no competition at all with the peaches, apricots, nectarines, pears and sweet cherries he brings to market each summer. In an area where the ground freezes to a 6-ft. depth, nobody else can grow them. No one else has a solar panel heated greenhouse.

“They said raising fruit trees like these in our area couldn't be done, and that bothered the heck out of me,” says Flynn. “In early August I pick apricots, two weeks later I pick nectarines and three weeks later I pick peaches.”

What makes Flynn's greenhouse orchard possible is the warm air beneath its soil and the double layer of plastic over the top. The warm air comes from three solar panels adjacent to the greenhouse. A grant from the Minnesota Department of Agriculture helped with costs.

“I have two 4 by 10-ft. horizontal panels and one 4 by 8-ft. vertical panel,” explains Flynn. “Hot air moves out of the panels through the dirt beneath the greenhouse and back into the panels for reheating.”

Flynn started by excavating a 30 by 48-ft. area to a 4-ft. depth. Wooden sidewalls made with utility grade 2 by 4's were covered with 4 in. of Styrofoam insulation for the top 2 ft. and 2 in. for the lower 2 ft. A 4-in. thick layer of foam panels covered what was to be the greenhouse floor. It was covered with 1 ft. of coarse sand and a layer of 4-in. corrugated drain tile on 16-in. centers. The tiles were covered with a second layer of 8 to 12 in. of sand. A second layer of drain tile on 16-in. centers was laid in the opposite direction. It too was covered with sandy subsoil, with 18 in. of topsoil laid over it.

“The corrugations give us 8 ft. of surface area for every 5 ft. of tile line,” explains Flynn.

A thermostat turns on fans when the air in the solar panels reaches 125°F and shuts them off when it drops to 85°. The fan pushes air into the panels after it has travelled through the tubes. In the heat of the day, the air gets really hot, notes Flynn.

“I was asked during a tour how hot the air was,” he recalls. “I put a plastic thermometer in the cold air return, and it was 72°. I put it in the hot air line, and the thermometer melted.”

Raised planting beds are a combination

of decayed peat available commercially and native soil. Flynn feeds plants with fish emulsion and liquid kelp through drip irrigation lines on each bed. He also treats each bed with composted manure from his herd of Scottish Highland cattle.

A framework of pairs of treated 4 by 4-in. posts spanned by 2 by 4-in. crossbars support aircraft cable running the length of the greenhouse. Tomato vines and cucumber vines are trained to run up lines to the cable.

In the dead of winter, the solar panels cannot stay ahead of the region's temperatures. The top 12 to 18 in. of soil freezes. Flynn is confident this helps control pests and disease.

“Our goal was to develop a system so a family or group of families could put up a high tunnel and grow their own fruits and vegetables,” says Flynn.

His greenhouse does that for him and his wife and much, much more. In addition to his farmers market stand, he also supplies a large commercial restaurant.

“A typical tomato plant grown outdoors here will produce 5 to 8 lbs. of fruit. We pick 50 lbs. without a problem,” says Flynn. “We picked almost 1,400 lbs. of cucumbers from a 14-ft. row.”



Plants are fed fish emulsion and liquid kelp through drip irrigation lines on raised garden beds.

The entire project, including labor and all materials, came to \$20,000. The 30 by 48-ft. ClearSpan high tunnel came from Grower's Supply and included double plastic on the roof with extra purlins to support the area's expected snowfalls. The solar thermal panels came from RREAL, a non-profit panel maker in Pine River, Minn.

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## “Made-It-Myself” In-Ground Greenhouse

Dean Steward built a 14 by 24-ft. “in-ground” greenhouse for just \$120. Going into the ground kept costs down and plants warm. He simply trenched out a walkway between ground level beds, walled it with concrete blocks, and covered the beds with cattle panels and plastic.

“I also have an outdoor garden, but our springs and falls are too cold to garden,” says Steward. “Now I can grow tomatoes into November and start lettuce and carrots early. Our tomato plants were 2 ft.

tall by the time I would normally be planting outside.”

Steward laid out his greenhouse with two 24 by 4-ft. beds separated by a 3-ft wide trench and two waist-high block walls.

“I used a backhoe to dig out the trench and laid the walls without mortar,” says Steward. “I drove rebar into each cell and rammed earth in to fill them. It has been more than a year, and they are holding well.”

He added concrete block steps at one end and built end-walls out of scrap lumber. For the roof, Steward drove in two lines of wood stakes, 10 to a side and 12 ft. apart. He fastened 16-ft. long, 50-in. wide cattle panels between the stakes and covered them with plastic.



Trench inside greenhouse forms a heat sink during the day, while concrete block walls release heat at night.

“I'm 5 ft., 8 in. tall but with the curve of the cattle panels, I can walk on the beds without hitting my head,” he says.

Steward explains that the trench forms a heat sink during the day and the concrete block walls soak up heat to release as outside temperatures cool.

“The tomatoes go crazy in it,” says Steward. “I take the plastic off when it gets hot enough in the summer and put it back on as it cools in the fall. When it does rain, the floor gets a little muddy, but it's not too bad and not that often.”

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Add-on “split wheel” is designed to fit onto the bottom round crossbar on swinging gates. The 2 parts bolt together and are held in place by 2 clamps.

## Add-On “Split Wheel” For Swinging Gates

Swinging gates on wheels are always easier to open and close than ones without wheels. This new add-on “split wheel” for hog gates lets you add a wheel to an existing gate without having to do any cutting or welding.

The 3 1/2-in. dia. split wheel comes in two parts that bolt together and is held in place by two clamps. It's designed to fit onto the bottom round crossbar on gates that are 3/4 or 7/8 in. in dia.

“It eliminates the need to cut and then re-weld the bottom bar. Requires no special tools,” says Vogt.

The Split Wheel sells for \$36 per wheel plus \$18 S&H. The S&H charge covers up to 8 wheels per box.

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