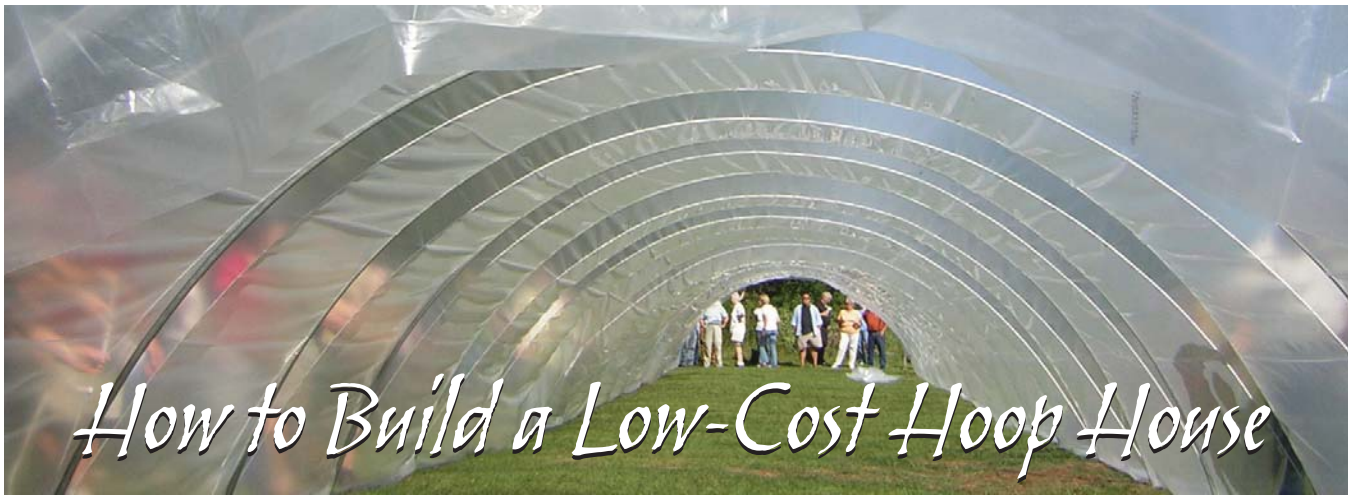

How to Build a Low-Cost Hoop House

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Tod and Jamie Hanley, of Trebuchet Gardens in Norman, have been working for several years to develop a low-cost, easy-to-assemble hoop house design as part of their commercial winter gardening business.

In 2007, the Hanleys received an Oklahoma Producer Grant from the Kerr Center to study the effects of different plastic hoop house coverings on temperatures inside the houses and yields of the crops grown in them.

As part of their grant project, the Hanleys also hosted a workshop at their farm in September 2008, to demonstrate just how they build one of their hoop houses. Over 100 people attended and learned the techniques, while helping the Hanleys to erect a new hoop house in just a few hours.

This guide is for others who would like to build a "Hanley-style" hoop house on their own. Illustrations and photos accompany the explanatory text, and a listing of materials, suppliers, and costs (as of September 2008) is included at the end.

Bending the Hoops

To make the hoops, the Hanleys start with straight 24-foot lengths of Allied galvanized one-inch square 16 gauge steel tubing, with a clear coat over the galvanizing. Their source is Wholesale Tube & Supply in Dallas.

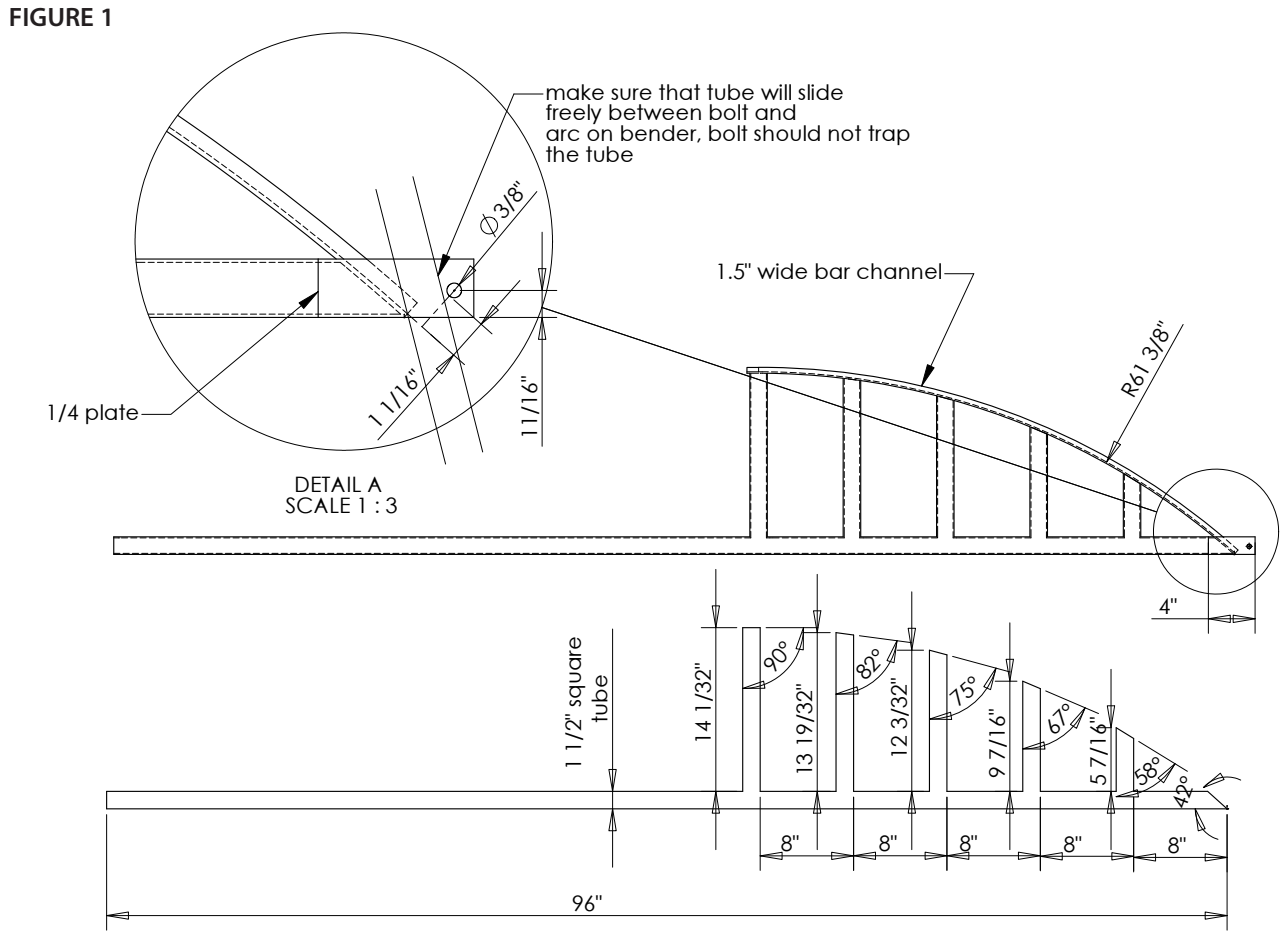
It takes 18 hoops to make a 100-foot-long hoop house. After bending, the hoops are 17 feet wide and 7-1/2 feet tall.

Figure 1 includes a diagram and dimensions for the bender. The operator simply slides the bender along a piece of square one-inch tubing, pushing down on the handle to form the correct curve.

"Bend each tube halfway, then turn around and start from the other end with the bender," Tod advises. "You end up with less of the tube sticking up in the air to manage." (See Figure 2.)

The Hanleys pre-mark the two end tubes/hoops for the centerline and for the eyebolts. They also attach wiggle-wire channel to the end hoops at this point (see Figure 3).

FIGURE 1



Why Square Metal Tubing?

"We tried fence toprail," says Tod. "It's hand bendable; but it turns into pretzels. Plus, it's round, so it's harder to keep the bender going in the same direction."

What about PVC? "It gets brittle after one or two years, costs more than metal, needs a latex paint coat not to eat up the plastic, and leaches toxins," Tod explains.

It's also easier to attach the flat wiggle-wire channel to square tubing than to round, he says.

The wiggle-wire channel comes in 12-foot sections from American Plant. It's also available from FarmTek in eight-foot sections, which can be patched together in sequence to cover the length of the hoop.

Pre-drill holes in the wiggle-wire channel at one-foot intervals. Then, drill into the bent tubing with sheet-metal screws, through the holes in the wiggle-wire channel. (Use pan head Phillips screws; hex heads will cut the plastic.)

Leave the last (lowest) hole on each side of the end hoops without a screw until after the hoop is placed on its pins.

While attaching the wiggle-wire channel to the tubing, the Hanleys lay the hoop on the ground and use rope and rebar to bend the hoop to the proper curve, since it won't bend once wiggle-wire channel is attached (see Figure 4).

As the hoops are bent, lay them out on the ground in the area where the house will be constructed, about six feet from each other.

FIGURE 2: Jamie Hanley uses a homemade tool to bend straight tubing into curved hoops, as her husband Tod explains the process to onlookers.

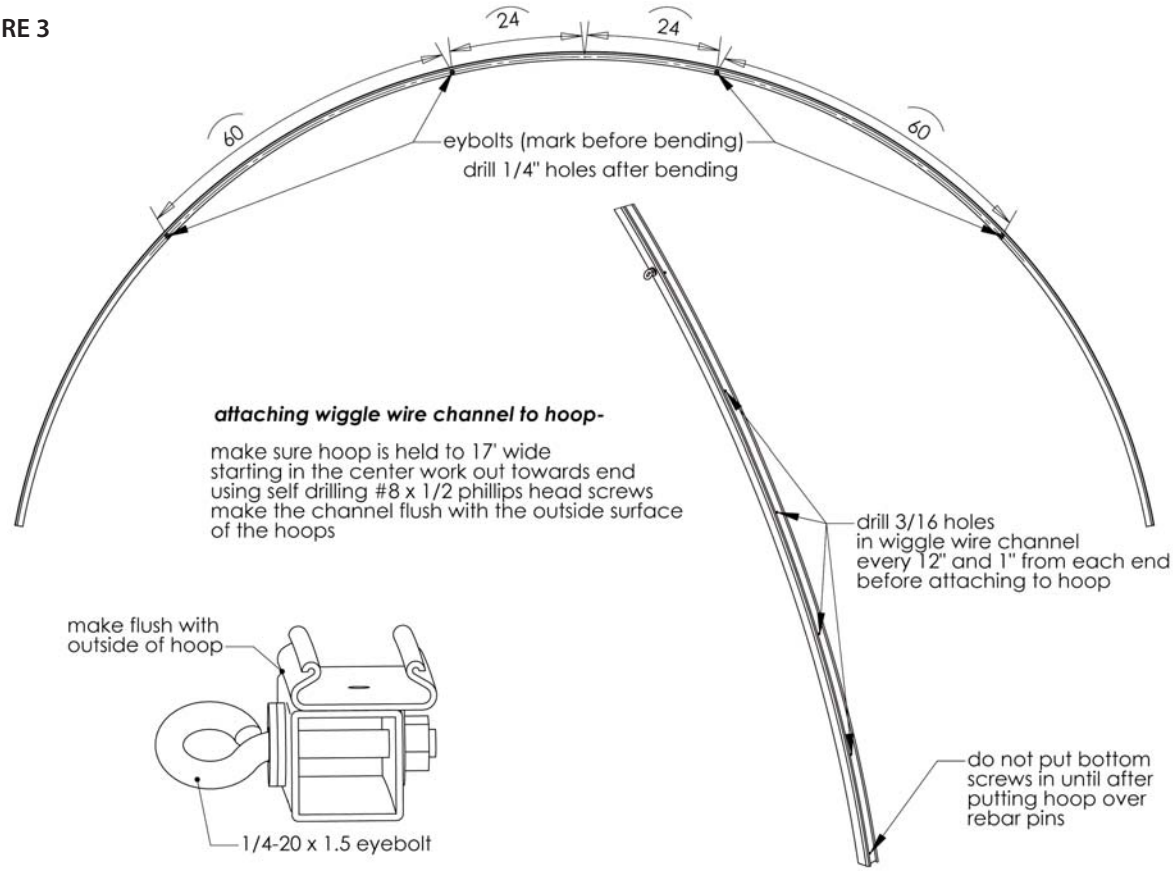
Laying out the House

"We orient the hoop houses lengthwise east and west to get the most sun in winter," says Tod Hanley. "In the summer the breezes out of the south provide better ventilation. North and south orientation reflects much of the low winter sun, and does not take full advantage of summer breezes."

The following instructions are based on the orientation of the hoop house constructed at the Hanleys' workshop, running east-west with the door end to the east.

The Hanleys buy 5/8-inch steel rebar in 20-foot lengths, then saw it into the lengths needed to make the pins that anchor the hoops in the ground.

FIGURE 3



In tighter soil, they have successfully used 17-inch pins, but in better-tilled soil, they've found that a 24-inch length is necessary for stability.

Pound one rebar pin into the ground; this will be one corner of the house. Then stretch a string from it running east-west along what will be one of the long sides of the hoop house (see Figure 5.)

Along the length of the line, at every point where the end of a hoop will be, pound a rebar pin into the ground. The pins should be angled slightly inward (about 15 degrees off the vertical, toward the center of the house), with about six inches left above the surface of the ground (see Figure 6).

The Hanleys separate the pins by six feet. "Five- to seven-foot centers are fine." Tod says. "Four-foot didn't move at all in wind. If it didn't have the ropes, the six-foot spacing would be too much."

With the first line of pins in place, the Hanleys then make two measurements to find the right location for the first pin in the second line:

1) From the first pin in the first line, measure 17 feet
2) From the fourth pin in the first line, measure 24 feet, nine inches

FIGURE 4: The Hanleys use rebar pins and rope to keep the ends of the hoops exactly 17′ apart while attaching wiggle-wire channel. Otherwise, the channel will make the hoop too stiff to bend to the right dimensions later.

FIGURE 5: Looking down the string that measures one of the 100′ sides of the hoop house.

FIGURE 6: Workshop participants pound the 5/8″ rebar pins, that will hold one end of a metal hoop, into the ground.

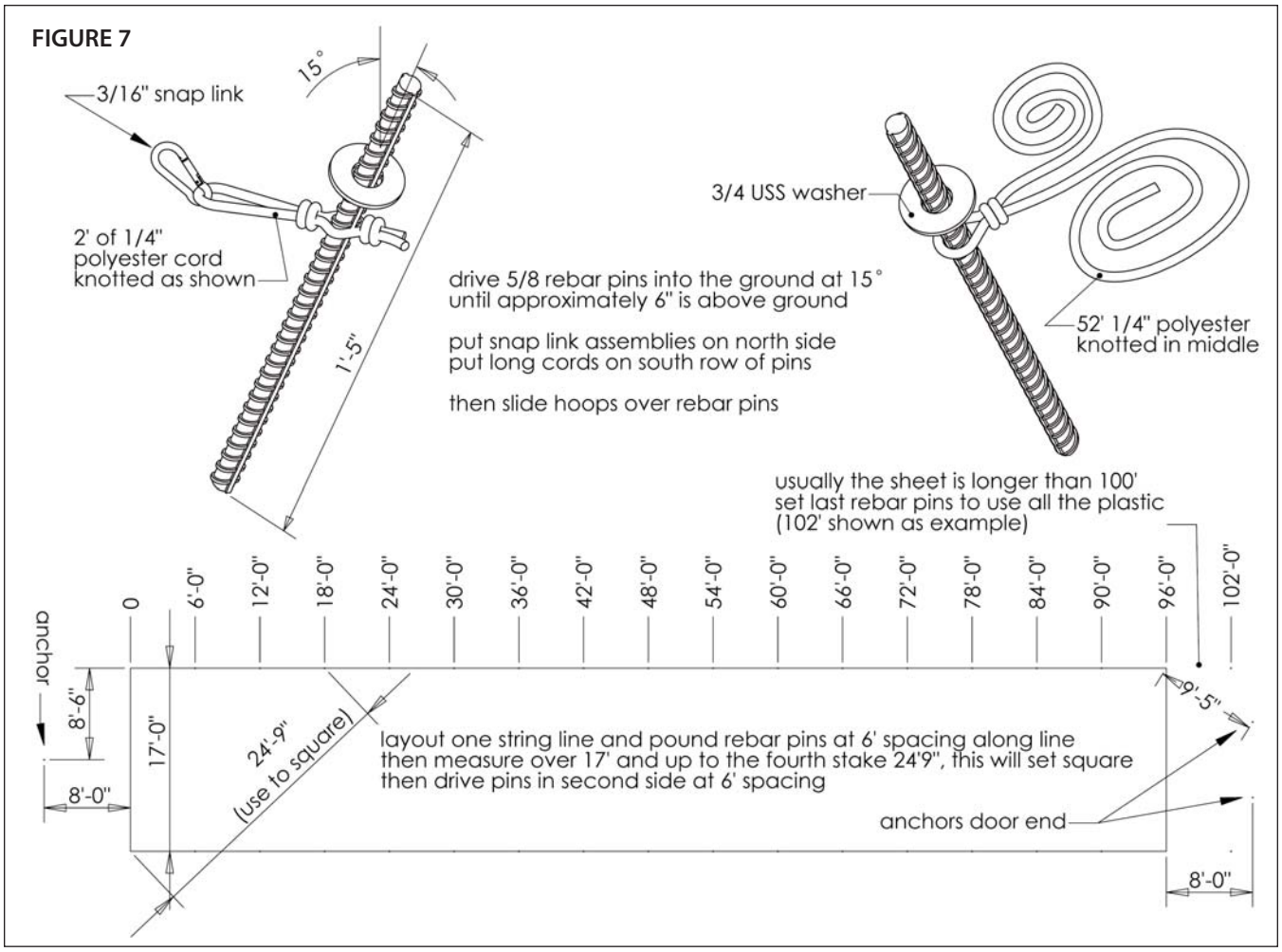


FIGURE 8: Workshop participants measure to position the end of the second 100' side of the hoop house. For the house to be square, the two end pins must be 17' from each other, and the second end pin must be 24'9" from the 4th pin down on the opposite side.

FIGURE 9: One small loop of rope, with a 3/16″ metal snap link attached, goes over each rebar pin on the north side of the hoop house. A washer slides over each rebar pin on top of the loop of rope.

Where these two measurements intersect is the correct position for the first pin in the second line (see Figure 7, bottom, and Figure 8).

Do not drive the final (westernmost) pair of rebar pins at this point; wait until the plastic is unrolled (see p.9).

Attaching the Ropes

After the rebar pins are driven, the ropes that will anchor the plastic roof can be attached to the pins.

By using double ropes across the top of the hoop house, the Hanley's design avoids purlins (rigid members running the length of the house, attached to the upper portions of the hoops). That reduces costs and simplifies construction, without sacrificing stability.

Over every rebar pin on the north side of the house (except the pins at either end), place a short rope loop, then slide a 3/4-inch USS washer onto the pin above the rope loop. The rope loops are two-foot pieces of rope that have been tied with a 3/16-inch snap link (see Figure 7, top left, and Figure 9).

On the south side, over every rebar pin (except at either end), place a loop tied in the center of a 52-foot piece of rope, again with a 3/4-inch USS washer sliding onto the pin after the rope loop. Stretch both ends of these ropes out on the ground to the south of the pins (see Figure 7, top right, and Figure 10).

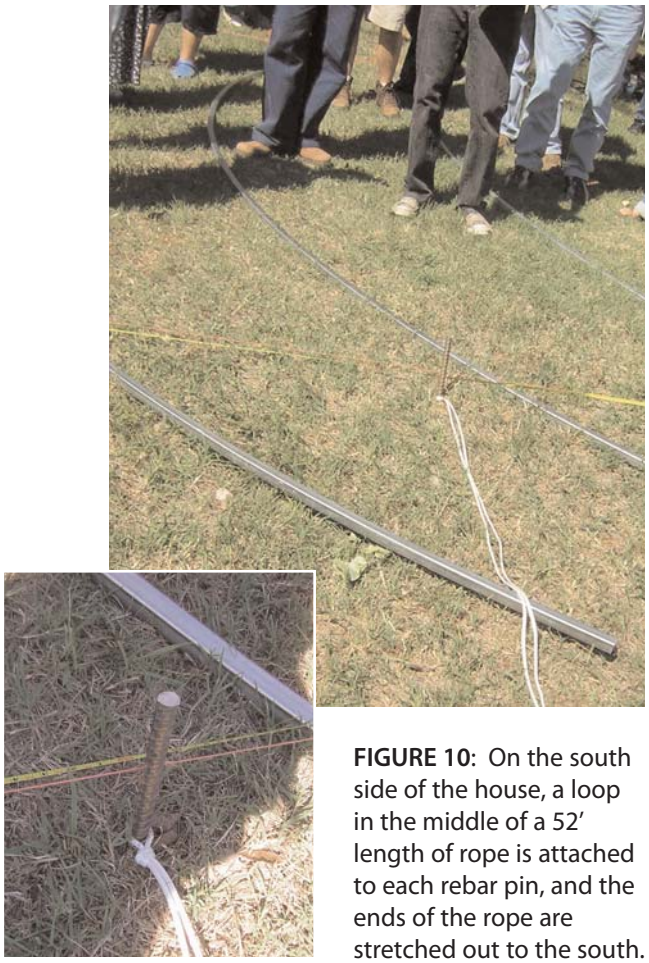


FIGURE 10: On the south side of the house, a loop in the middle of a 52′ length of rope is attached to each rebar pin, and the ends of the rope are stretched out to the south.

Learning the Ropes

The Hanleys use 1/4-inch polyester rope from FarmTek, where they buy it in 1,000-foot rolls. "Darker colors are supposedly better in the sun," Tod says.

They had previously tried polypropylene, but "it was shot after one year."

Nylon parachute cord survived the sun, but stretched too much.

FIGURE 11: Workshop participants help to erect the hoops for the hoop house.

Setting up the Hoops

In the two end hoops, drill holes in the pre-marked locations for the eyebolt anchors. Two eyebolt anchor holes are required on both sides of the end hoop (see Figure 3).

Once the anchor eyebolts are attached to the end hoops, place the first (eastern) end hoop on its rebar pins. The second (western) end hoop will be erected later, after the plastic is unrolled (see p.9). When the end hoop is in place on its rebar pins, screw the ends of the wiggle-wire channel to the ends of the hoop.

Place the remaining hoops on their rebar pins, moving from east to west (see Figure 11).

Place two auger-style earth anchors in the ground eight feet away from the east end of the house. At the door end, the earth anchors are placed at the point where a nine-foot, five-inch line from the corner pin intersects a line parallel to, and eight feet out from, the end of the house (see Figure 3, bottom right, and Figure 12).

At the non-door end, a single earth anchor is placed eight feet from the end of the house, on the centerline of the house (see Figure 3, bottom left). (Note that the earth anchor for the west, non-door end of the house is not placed until later, after the plastic is unrolled; see below.)

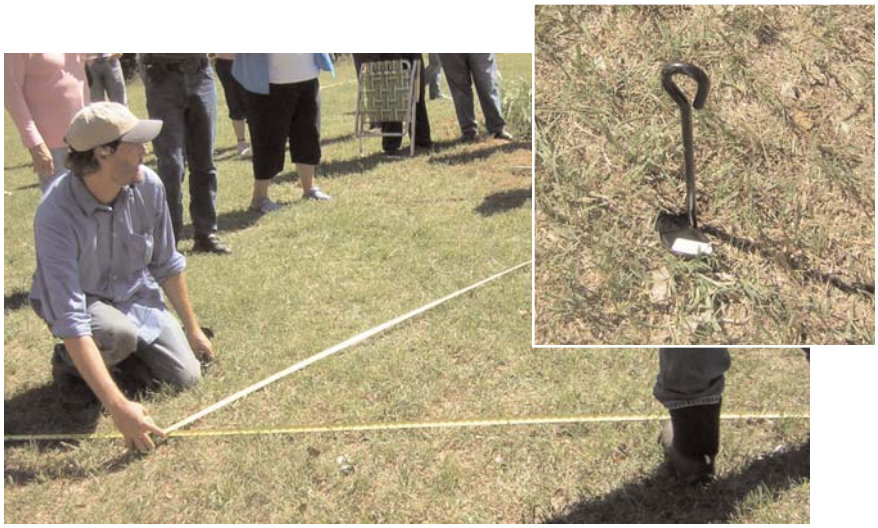


FIGURE 12: Tod Hanley and workshop participants measure to position the anchor at the door end of the hoop house. On the door end, two anchors are positioned 8′ from the end hoop and 9′5″ from either of the rebar pins holding the ends of the end hoop. On the non-door end, a single anchor is positioned on the centerline of the hoop house, 8′ from the end hoop.

FIGURE 13: The Kerr Center's Doug Walton helps to position the 100' roll of plastic, to be unrolled over the ropes stretched out on the south side of the hoop house. The Hanleys stick two garden forks in the ground, and run a piece of pipe between the handles of the forks and through the center of the roll of plastic. This allows just one person to unroll the entire roll of plastic just by walking.

Attaching the Plastic

For covering their houses, the Hanleys use a sheet of six-mil plastic, 100 feet long by 24 feet wide, rated to last for four years. (This is available from American Plant in Oklahoma City; FarmTek also sells a 26-foot wide roll.)

Untangle the halves of the ropes that are stretched out to the south from the bottoms of the hoops on the south side of the house. Then, unroll the full length of the sheet and spread it on top of the ropes (see Figure 13). (The Hanleys stick a pair of spading forks into the ground to hold up the ends of the roll, so that one person can unroll the plastic just by holding the end of the sheet and walking.)

When the plastic is unrolled, drive the final two (westmost) rebar pins in a position that will use the full length of the plastic. (Hanley says that the roll of plastic is usually longer than 100 feet, but the extra amount is not consistent, so it's necessary to wait and see how long the roll is before driving the final pair of rebar pins.)

Set the final (west) end hoop over the pins, and screw the ends of the wiggle-wire channel to the ends of the hoop.

FIGURE 14: Tod Hanley explains the technique for attaching the ropes to the hoops. A bowline knot (held by Hanley in the photo), tied in one end of a rope whose other end is attached to the south side of the house, goes over the plastic roof and attaches to the metal snap link.

In the end of one of the ropes that are now covered by the plastic, tie a bowline knot to make a loop at the end of the rope (see Figure 14).

Carry that end of the rope over the top of the plastic to the opposite end of the hoop, and attach it to the snap-link there (see Figures 15, 16). Do this once for each hoop.

FIGURE 15: Tod Hanley carries the end of a 52′ rope OVER the plastic to the opposite pin on the north side of the house. By unrolling the plastic on top of the ropes when the ropes are on the ground, and then pulling the ropes across on top of the plastic, a guide is created so that when the plastic is pulled over the tops of the hoops, it will have the hoops underneath it and the ropes above it. This helps with installing and removing the plastic on windy days.

Pull the edge of the plastic up over the hoops and down to the ground on the north side. The plastic moves in between the hoops and the ropes, which help to trap and guide the plastic – an advantage on windy days (see Figure 17).

After the plastic is stretched over the hoops, attach it to the end hoops with wiggle wire (see Figure 18).

As its name suggests, the wiggle wire is a length of wire bent into a zigzag pattern. Its edges hold the plastic cover against the inside edges of the wiggle-wire channel.

"It may not look like it, but the wiggle wire is the most dangerous thing we've got out here," says Tod Hanley. It can easily twist in the hands to cut or poke the unwary user. "It also costs more per foot than the hoops," he adds.

"Wiggle wire allows removal of plastic in five minutes, and doesn't tear your plastic," Tod says. "It's well worth the money."

Once the wiggle wire has attached both ends of the plastic sheet to the end hoops, take the rope ends that still remain on the ground on the south side, throw their free ends over the top of the hoop house, and tie them to the metal snap-rings (see Figure 19).

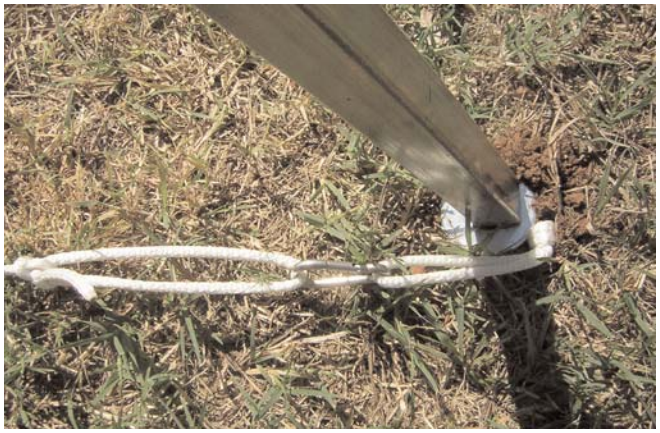


FIGURE 16: One end of one of the 52′ ropes tied to the rebar pins on the south side of the house, tied with a bowline knot through the 3/16″ metal snap link in the rope on the opposite pin on the north side of the house.

Attaching the End Walls

For the door end, the Hanleys usually build a frame and install a surplus storm door. This provides more stability and convenience, and also lasts longer.

The Hanleys did not install the frame or door in the door end on the day of the workshop. Thus, the only step left to perform on the door end was to tie the anchor eyebolts to the earth anchor (see Figure 3, bottom right, and Figure 20).

In the Hanleys' design, the non-door end does have a zipper door that can be opened to increase ventilation.

Each end wall is a 10-foot by 17-foot sheet of the same type of plastic used for the roof covering.

To install the end wall on the non-door end, remove the wiggle wire from the end hoop on the non-door end. From the inside of the hoop house, tuck the top of the end-wall plastic under the roof plastic. Start with the bottoms on both sides, and end with the middle.

(The reason for inserting the top of the end wall sheet from the interior of the hoop house is that it keeps the sheet from having to be punctured

FIGURE 17: Helpers from the workshop audience stretch plastic over the hoops to cover the hoop house.

FIGURE 18: Tod Hanley supervises workshop participants as they attach the plastic to the end hoops with wiggle wire.

FIGURE 19: Workshop participants prepare to tie the second ropes down over the plastic.

for the anchor ropes to tie onto the anchor eyebolts.)

Re-attach the wiggle wire to hold both sheets (roof and end wall) in place, and then trim the excess plastic. Attach and tighten the anchor ropes.

The zipper that opens and closes the end wall on the non-door end has an adhesive back that attaches directly to the plastic. Attach the zipper, unzip it, and then cut the plastic of the end wall in between the unzipped teeth (see Figure 21).

The zippers are available from Home Depot, but the Hanleys get them wholesale for much cheaper, and will resell them for less than the commercial retail price.

Jamie Hanley says that they usually have to replace each zipper at least once per winter. But since the zipper just peels away from the plastic, only the zipper, rather than the whole end wall, needs to be replaced.

FIGURE 20: Tod Hanley attaches anchor ropes to the eyebolts in the end hoop at the door end of the house.

Ventilating the House

Since hoop houses rely entirely on passive means of both heating and ventilation, they require active management. Even in cooler months, ventilation is often necessary during the warmer parts of the day, sometimes requiring the sides of the house to be raised and lowered daily.

The Hanleys' design reduces the time and effort required for this chore. The tension that the double ropes and the metal hoops exert on the plastic cover will hold the edges of the cover at any height desired, and the height can be changed simply by pulling up or down on the edges of the plastic (see Figure 22).

For that reason, the Hanleys' design does not require the edges of the plastic to be covered with earth or other anchoring/insulating materials, as some others do. "We never cover the south side," says Tod Hanley. "We only put dirt on the north side in winter."

FIGURE 21: Jamie Hanley leads workshop participants installing a zipper door in the non-door end of the hoop house.

FIGURE 22: Workshop participants raise the plastic sides of the hoop house - the primary means of ventilating the structures. The tension between the side ropes and the hoops holds the plastic at any height desired.

HOOP HOUSE PARTS AND SUPPLIERS

(as of September 2008)

QTY.	DESCRIPTION	PRICE	SUPPLIER	PHONE	NOTES	LINE TOTAL
1	100' x 24' Tufflite 6-mil 4-year greenhouse film	$231.66	American Plant, OKC (Wholesale)	1.800.522.3376	also available from FarmTek in 26' width	$231.66
0.33	100' x 10' Tufflite 6-mil 4-year greenhouse film	$96.53	American Plant, OKC (Wholesale)	1.800.522.3376	also available from FarmTek for ends, only need 33'	$31.85
18	1" square x 16 ga galv. 24' long	$24.48	U.S. Wholesale Pipe & Tube, Inc.	call Tod Hanley 405.812.5982	shipping can be high from Dallas, appr. $180; or consolidate load for free	$440.64
3	5/8" rebar x 20'	$10.53	Hardware store		saw into 17" lengths (24" if in well-tilled soil)	$31.59
36	3/4" USS flat washer	$0.63	Hardware store			$22.55
8	1/4" x 1-1/2" eye bolt	$0.70	Hardware store			$5.60
24	1/4" flat washer	$0.03	Hardware store			$0.77
8	1/4" - 20 hex nuts	$0.06	Hardware store			$0.48
56	8 x 1/2" self-drilling screws	$0.06	Hardware store			$3.25
1	1/4" #8 polyester rope 1,000' roll	$83.95	FarmTek p/n CC5525	1.800.327.6835	Do not use polypropylene.	$83.95
6	8' aluminum poly latch single channel	$7.69	FarmTek p/n 102197	1.800.327.6835		$46.14
6	stainless steel spring wiggle wire - 0.83	$1.82	FarmTek p/n 102198	1.800.327.6835		$10.92
3	auger style earth anchor 1/2" x 15" x 4"	$4.79	FarmTek p/n CC6250	1.800.327.6835		$14.37
18	3/16" SS snap link	$1.00	FarmTek p/n AS3150 ($3.24)	call Tod Hanley 405.812.5982	This is a case price for wholesale.	$18.00
3	7' zip-up zippers peel and stick	$7.50	Home Depot ($15.56)	call Tod Hanley 405.812.5982	This is a case price for wholesale.	$22.50
					TOTAL	$964.27