



## Constructing a Low-Cost High Tunnel for Tall Crops (14.5' wide by 10' tall)

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High tunnels can be effective for both season extension and frost protection. There are many different designs and materials used for high tunnel construction. When deciding what high tunnel you will construct, it is important to evaluate your needs. First, determine what type of crops you will be growing in the tunnel. Low-growing crops, such as spinach or strawberries, can be grown in a lower profile high tunnel. However, crops such as raspberries, blackberries, or indeterminate tomatoes require a tunnel with a taller profile. Construction materials should also be selected based on tunnel design needs and budget. A tunnel made with galvanized steel is very strong, but expensive. PVC tunnels are less rigid (although still quite sturdy), but cost significantly less to construct. PVC frames are also more flexible, which can be an advantage when wind or snow load exceed design strength, as PVC frames may flex back to their original shape, whereas steel frames will permanently fail.

This fact sheet provides construction details and a list of materials and associated costs for a tall-profile, low cost tunnel. Detailed instructions for building a lower profile high tunnel can be found at <http://tunnel.usu.edu>.

This tunnel is 14.5 feet wide by 10 feet tall and has been used successfully for raspberry production in North Logan, Utah. To build a high tunnel, you will need a shovel, circular saw, electric drill, drill bits,

sledge hammer, ladder, and a measuring tape. Table 1 provides the materials list for constructing the tunnels. The cost of wood materials was determined by averaging 2014 prices across three Logan, Utah lumber stores. Greenhouse plastic cost was an average of three retailers, two online and one local. The remaining materials were an average of prices between two home repair stores.

### Site Selection

Start by selecting a site for the high tunnel. Choose a location with well-drained, weed and disease free soil. Make sure the site has access to year-round water. Access to electricity is not required but beneficial. Orient the tunnel to be parallel to the strongest prevailing wind and avoid building where any part of the tunnel will be shaded.

### Construction

**ENDWALL:** Measure out and mark where the four corners of the tunnel will be. Reference Diagram 1 for endwall measurements and angles. The 4x4 endwall supports should be buried 4 feet below the soil line, cut off 2 feet of the post, leaving 10 feet above the soil line. Build the endwall around these supports.

**TUNNEL:** Reference Diagram 2 for tunnel construction. The hoops are spaced at 3 foot intervals between the two endwalls. Measure out

and mark the point where the base of each hoop will be. Pound a 2 foot rebar anchor in at each point, leaving 6 inches above the soil. Dig a 3 foot hole for each 4x4 support and anchor in each 8 foot 4x4 (leaving 5 feet above the soil line). Run the 2x4 supports between each endwall, securing them to the 4x4 supports and connecting the lengths with metal braces (Figure 1).

PVC pipe comes in 10 foot or 20 foot lengths and hoops for this tunnel are 30 feet long. When purchasing the PVC pipe, either buy all 20 foot lengths and cut some in half or purchase 20 foot and 10 foot lengths. Glue one 20 foot and one 10 foot PVC length together with PVC glue. Each end of the pipe will be fitted onto the rebar and anchored to the 2x4 side supports with plumbers tape or conduit-hangers (Figure 1).

### Doors

Each endwall has three door openings: one tall main doorway (Diagram 3) and two equipment side doors (Diagram 4). Making the side doors to open is

optional, but opening them allows better access to the furthest sides of the tunnel for small equipment such as a tiller, and to improve ventilation. A top vent can also be constructed. To open properly, the top vent must be beveled on one end. Cut an angle on the inside of the vent, along the top board (Diagram 5). Doors should be covered with plastic remnants, by wrapping plastic edges around lath and drilling a screw through plastic and lath to connect to the 2x4 frame.

### Plastic

Installing plastic over the tunnel will take at least two people and should be done on a day with little or no wind. Center plastic over the high tunnel and secure to the end wall, starting at the peak, using lath strips and screws as described above. Once one end is secure, pull plastic as tight as possible and secure the other end, again working down from the top to the bottom. Rope can be stretched over the tunnel between the arches to put additional tension on the plastic, preventing the plastic from flapping against the frame in the wind.



Figure 1. 2x4 side supports connected to PVC hoops and 4x4 anchor. Coils of rope attached at the base of each arch will be stretched over the tunnel to further tension the plastic.

Table 1. Materials needed to construct a high-profile high tunnel and their associated costs. Quantities and costs are presented for constructing tunnels 14 feet wide and in lengths of 45, 90, or 140 feet. Costs were determined based on materials prices in April 2014.

<u>Tunnel</u>	<u>Quantity</u>			<u>Unit Price</u>	<u>Cost</u>		
	<u>Tunnel Length</u>				<u>Tunnel Length</u>		
	45'	90'	140'		45'	90'	140'
6 mil greenhouse plastic (32' wide)	50'	100'	150'	\$3.10 / ft*	\$155.00	\$310.00	\$465.00
1" schedule 40 PVC pipe - hoops	480'	930'	1530'	\$0.30 / ft	\$144.00	\$279.00	\$459.00
1" schedule 40 PVC pipe - ridge purlin	50'	100'	150'	\$0.30 / ft	\$15.00	\$30.00	\$45.00
PVC cement to glue purlin lengths		1 pint		\$5.70		\$5.70	
Cross connectors for purlins	14	29	49	\$2.35	\$32.90	\$68.15	\$115.15
White exterior latex paint for PVC hoops	1 qt	2 qts	3 qts	\$15 / gal.	\$15.00		
8' 2 x 4 side supports	24	48	70	\$2.78	\$66.72	\$133.44	\$194.60
10' 4 x 4 (treated) side supports	3	6	11	\$16.57	\$49.71	\$99.42	\$182.27
Metal bracing for side supports	10	22	33	\$2.87	\$28.70	\$63.14	\$94.71
Plumbers hanger strap	25'	50'	75'	\$5.47 / 25ft	\$5.47	\$10.94	\$16.41
1/2" x 24" pre-cut rebar pins	28	58	98	\$1.84	\$51.52	\$106.72	\$180.32
Polyester Curtain Cord (1/8" x 1000')	1	1	2	\$29.22	\$29.22	\$29.22	\$58.44
<b>Tunnel subtotal</b>					<b>\$598.94</b>	<b>\$1,130.03</b>	<b>\$1,810.90</b>
*Purchasing only 50 ft of plastic may cost more per ft than 100+ ft							
<b><u>End walls</u></b>							
Lumber - 8' 2 x 4		12		\$2.78		\$33.36	
16' 2 x 4 (treated)		2		\$12.57		\$25.14	
Corner reinforcing braces		lumber scrap					
16' 4 x 4 (treated) for end wall support		4		\$30.00		\$120.00	
4' lathe (bundle of 50)		1		\$15.39		\$15.39	
Wood screws - 3" construct wall		1 box		\$9.37		\$9.37	
- 1 5/8" to attach lath to end wall		1 box		\$9.37		\$9.37	
White exterior latex paint		1 gal		\$15.00		\$15.00	
<b>End Walls subtotal</b>					<b>\$227.63</b>		
<b><u>Main Doors (2 doors per end wall)</u></b>							
Plastic (3.5' x 8')		4				8.96	
Lumber: 8' 2 x 4		14		\$2.78		\$38.92	
Paint		left from end walls					
Hinges		8		\$2.39		\$19.12	
Gate Latch		2		\$1.37		\$2.74	
<b>Main Doors subtotal</b>					<b>\$69.74</b>		
<b><u>Side Doors (2 doors per end wall)</u></b>							
Plastic (4' x 5')		4		\$0.08 per ft <sup>2</sup>		6.4	
Lumber: 10' 2 x 4		4		\$4.25		\$17.00	
8' 2 x 4		6		\$2.78		\$16.68	
Paint		left from end walls					
Hinges		8		\$2.39		\$19.12	
Gate Latch		4		\$1.37		\$5.48	
<b>Side Doors subtotal</b>					<b>\$64.68</b>		
<b>Tunnel Total</b>					<b>\$960.99</b>	<b>\$1,492.08</b>	<b>\$2,172.95</b>

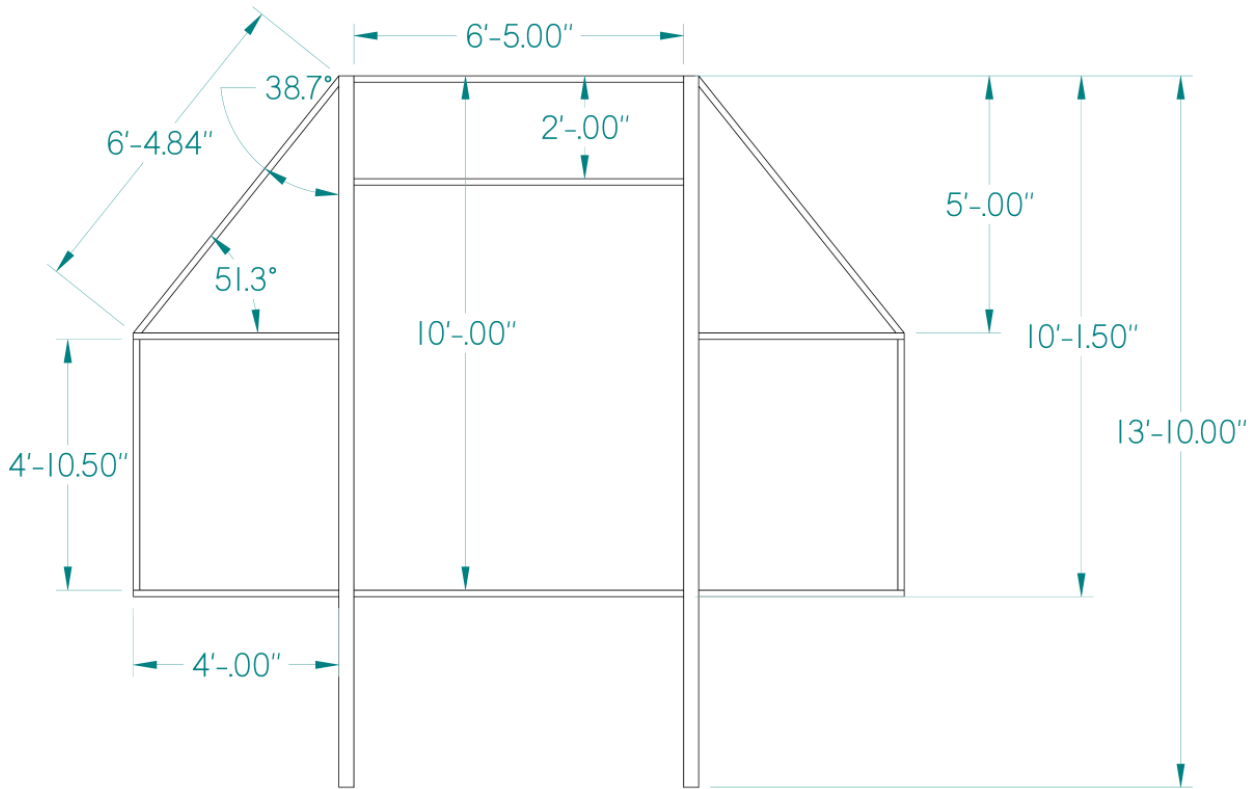


Diagram 1. End wall construction blueprint.

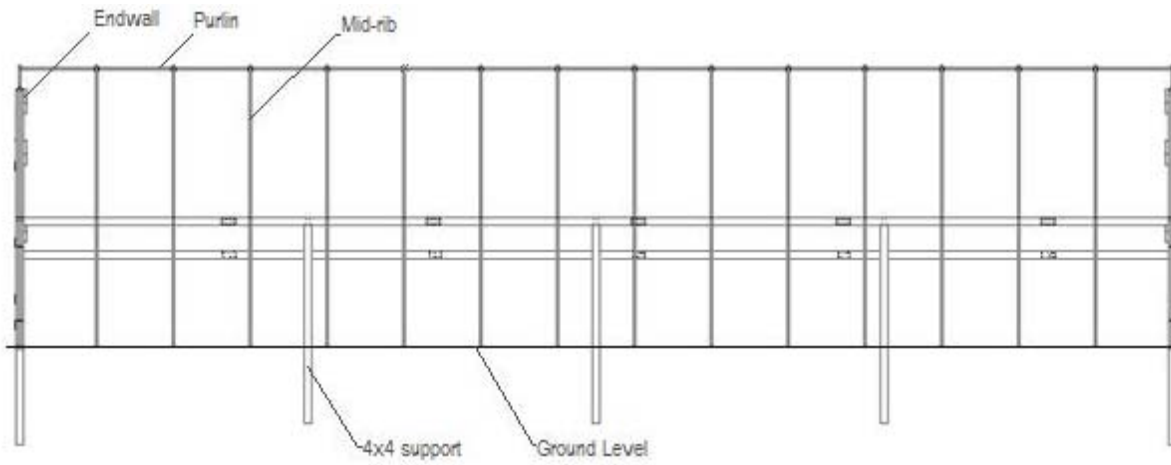


Diagram 2. Tunnel construction blue print. Hoops are placed every 3 feet and 4x4 supports every 10 feet.

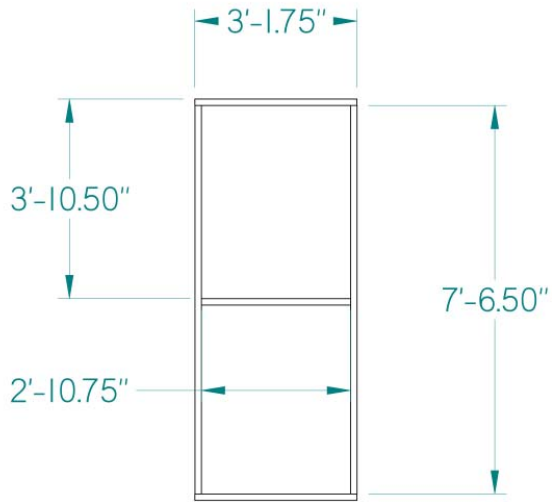


Diagram 3. Main door, one side only. Two of the above doors should be constructed and hung so they will open as double doors

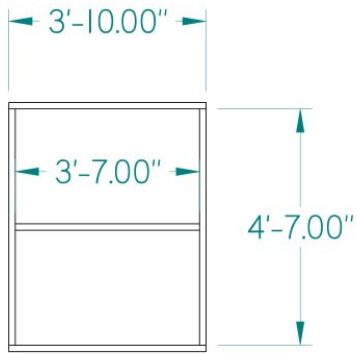


Diagram 4. Side door. Two needed for each end wall.

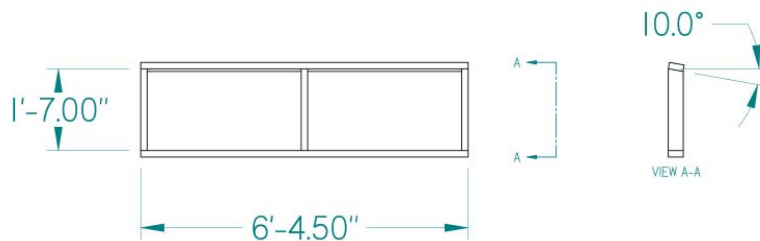


Diagram 5. Top vent, and side view showing needed beveling to allow for proper opening and closing.



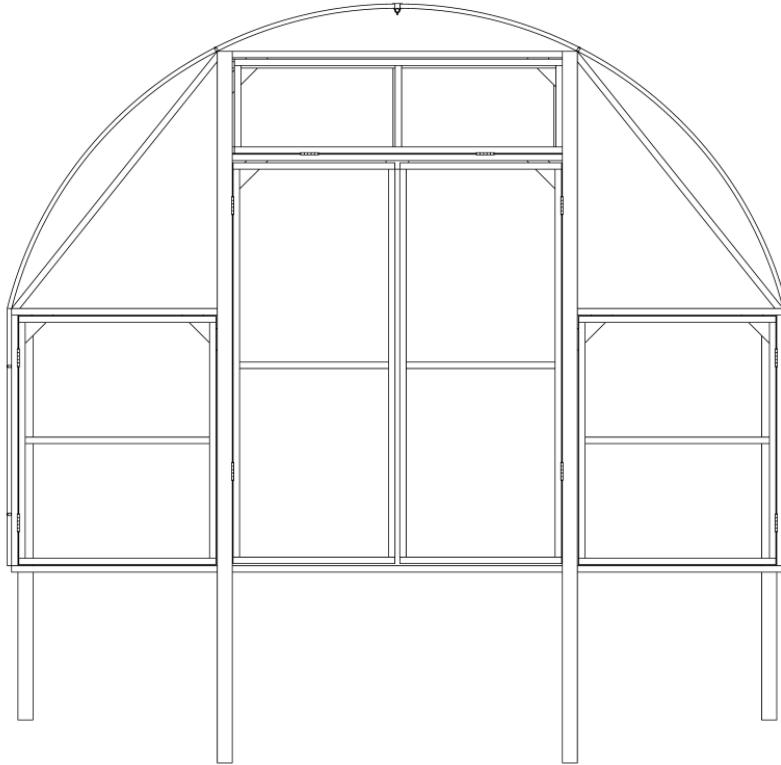


Diagram 6. View of end wall with hoops and doors completed.

Diagrams were composed by Scott Thorne, USU student.

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