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Western Australian Department of Agriculture

Agdex 731
Crop growing buildings

Building a plastic tunnelhouse

By Officers of the Division of Horticulture, South Perth

The tunnelhouse described here is based on selected ideas from similar units. It is designed to withstand local weather conditions and to make best use of the natural environment to grow horticultural crops without artificial heating or cooling. It is a low cost house, easily constructed with a minimum of labour.

The term 'tunnelhouse' generally refers to all types of greenhouse with plastic or similar sheeting stretched over a U-shaped frame, and where the plastic sheeting can be changed to suit seasonal conditions. This differentiates a tunnelhouse from the familiar conventional-shaped glasshouse, but both perform the same task.

Double-skin, inflated plastic sheeting may be fitted on tunnelhouses that need greater heat retention for winter crop production, particularly where supplementary heating is necessary for forced crop production. Rotating plastic covers and shade-cloth material from winter to summer will help to extend the life of the plastic sheeting.

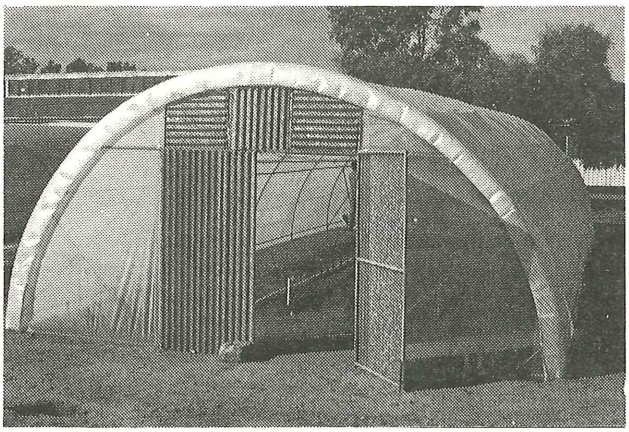

Figure 1. A finished tunnelhouse. Louvres above the doors and plastic film are optional

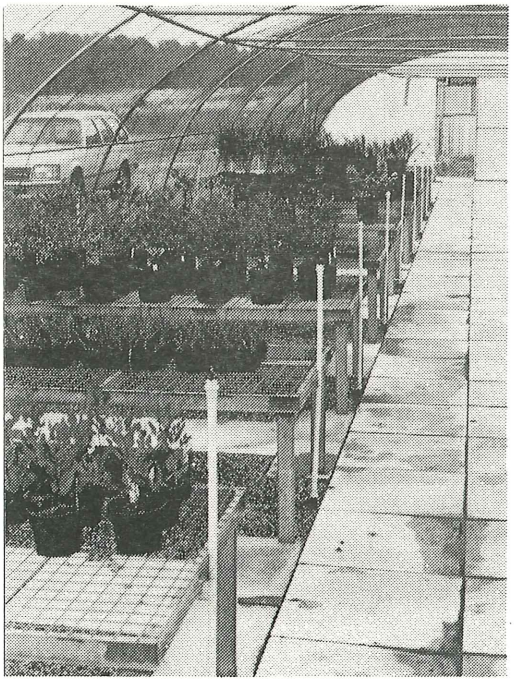

Figure 2. Shade-cloth cladding for perennial or summer crops

Site preparation

The tunnelhouse should be built on a level area about 18 metres by 8 metres.

The tunnelhouse frame consists of fourteen 75 centimetre lengths of 32 millimetre arch support tube pre-drilled with 8 mm holes about 3 cm from one end.

Drive the tubes into the ground at 2.54 m intervals along two parallel lines 6.7 m apart. The tubes are driven in until they are level and about 5 cm above ground.

Take care not to burr the inside of the tubes.

Arch fabrication

Weld the pipe for the arches into 10.2 m lengths. These are then put through an arch-shaping device to form the required shape. The first 30 cm at each end is straight and the following 100 to 120 cm is curved, but not to the same degree as the remainder of the arch. This results in a horseshoe-shaped arch which adapts to the required shape when sprung into the leg support tubes.

An alternative to using a shaping device is to bend the pipe around a set of pegs driven into the ground (see Figure 4). If this method is used, it may be necessary to fabricate the arches in two halves, which are then joined.

Bracing

All bracing is cut to length, and bent and drilled where necessary once the arches are in position. Offcuts from arch fabrication can be welded together for corner bracing. Drill all the outer holes in the bracing with a 10 mm drill to accommodate the square shank of the cuphead bolts (see Detail B).

Ends and entrances

Build in the ends, doorways and doors after the arches are erected. Each door is built to accommodate the width of a sheet of standard corrugated fibreglass sheeting. Restraining pins made from 13 mm rod are fitted to the inside bottom edge of each door. These pins drop into 15 mm pipes driven into the ground to hold doors open or closed.

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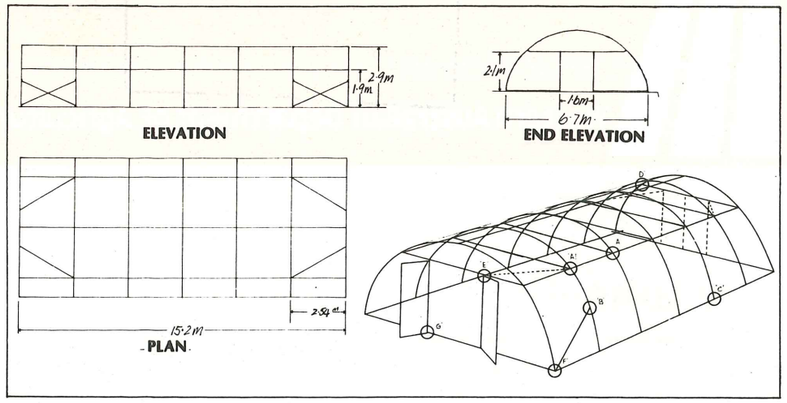


Figure 3. Elevation, plan and three dimensional view of single layer plastic tunnelhouse (detail of pipe joints is shown in separate drawings)

Erection

The leg of each arch is sprung and inserted 20 cm into the leg support tubes. Drill an 8 mm hole through the leg via the pre-drilled hole in the support tube and fit a 6 mm high tensile hexagon bolt (see Detail C).

The screwed and socketed lengths of pipe for the longitudinal bracing are then marked and drilled together with the arches in the positions shown in Detail A, and bolted in place on the underside of the arches. Screw each succeeding length into the previous one.

Cut pipes for the transverse braces to length and fix into position on the longitudinal braces immediately adjacent to the arches, which are bent and fitted to the arches with clamps (see Detail D).

Following this, the end framework is cut to length and fixed into position with clamps - see Details E, F and G.

The corner bracing is cut to length, bent and bolted or clamped into position (see Detail B).

Note: Cover all joints with strips of plastic taped into position, or with PVC tape, to prevent tears in the plastic cover.

Plastic cover

Eleven metre wide Infrasol® is convenient for a tunnelhouse of this size, because it eliminates any need to join the sheeting. Other types of film may have to be joined. Cut the cover 0.8 m longer for overlap and welding of a 75 mm hem to take a nylon cord for fixing at each end.

Alternatively the film could be cut 1.2 m longer so that 0.3 m can be folded back over each end arch to form a hem with a cord inserted for fastening to a star picket (see Figure 5). The film can be kept firmly in position by tying the overlap and pulling it down over the end arch.

Seal both ends of the tunnel with the same 150 micron plastic used for the cover. Weld the plastic into position on site with a plastic welding iron. After the welding around the arch and door frame is finished, the bottom edge of the plastic sheet is dug into a shallow trench.

Fitting the cover

Dig a narrow trench about the width of a spade and 300 mm deep along either side of the tunnelhouse, outside of and immediately adjacent to the arch support tubes. Then roll the cover out over the framework and pull it square, with equal overhang on the sides and each end.

The plastic is carefully buried along one side of the house and firmly tramped in. Along the other side, the plastic is held clear of the bottom of the trench, the soil heaped on and the plastic allowed to gradually sink to the bottom of the trench. This operation, applied progressively along the trench, ensures that the cover is slightly tensioned and there are no wrinkles. Once again, the soil should be firmly tramped down (see Figure 6).

Note: Fit the cover during warm conditions so that it may be stretched into position as tightly as possible. This will ensure that sagging is kept to a minimum during hot weather.

The next step is to fasten the ends by driving in a 50 cm star picket at each corner to secure the nylon cord. A short piece of 13 mm trickle tube is placed over the cord and inserted in the slot cut in the hem to prevent tearing. The ends of the cover can

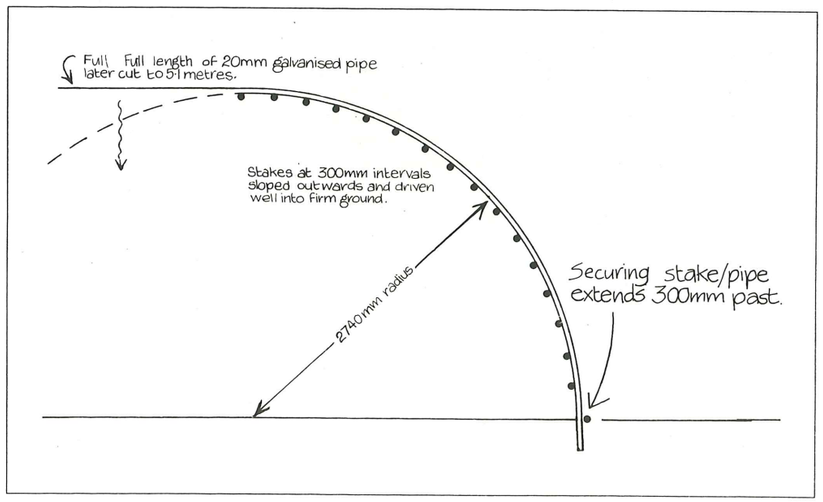
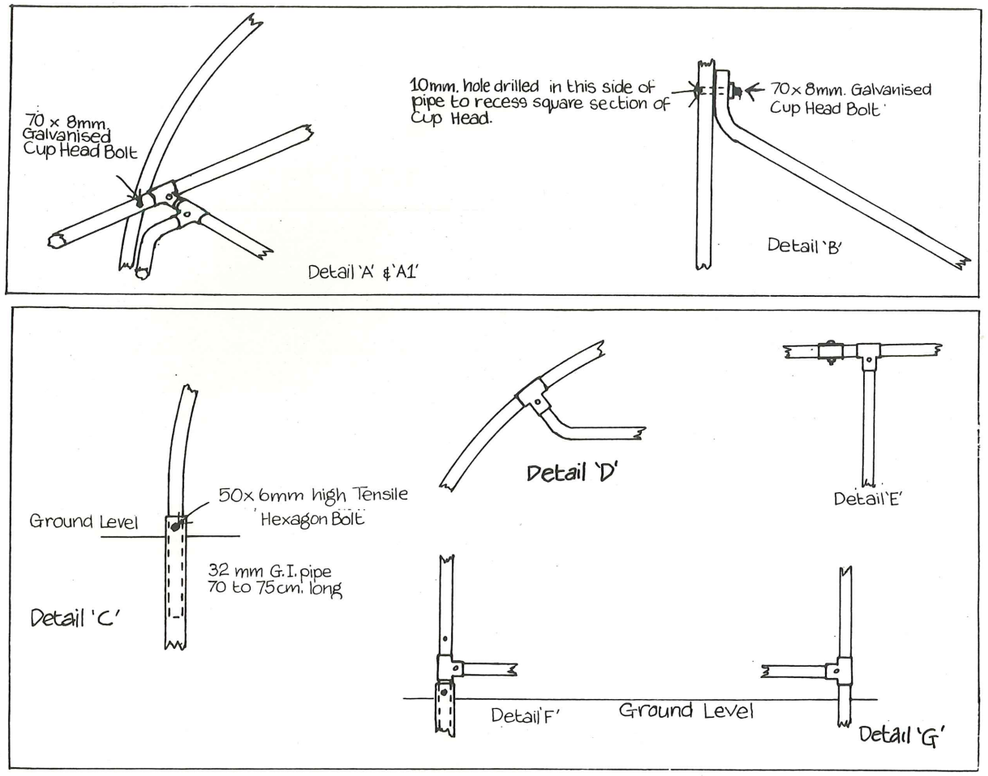


Figure 4. An alternative method for bending pipes; pegs sloping outwards and at 300 mm intervals are driven firmly into the ground



be then tightened by driving the stakes in as may be required.

After fitting the doors and sundry bolts and catches, the house is ready for use.

Shade-cloth cover

Where the house is used to grow perennial or summer crops that require shading, effective protection may be achieved by making the following modifications.

As mesh is necessary to support a shade-cloth cover, extra longitudinal braces have to be fitted. Braces made from 25 mm by 1.6 mm galvanized ERW tube are bolted to the arches about 100 mm above the ground each side of the house. Braces from 19 mm by 1.6 mm galvanized ERW tube are bolted to the arches midway between the existing longitudinal braces.

Cut roof safety mesh into lengths to fit over the house between the arches and fasten to the lower longitudinal braces. The shade-cloth cover, made to measure with reinforced hems and eyelets at 300 mm intervals, is secured to the house with nylon blind cord at each end and either side at the ground level (see Figure 7).

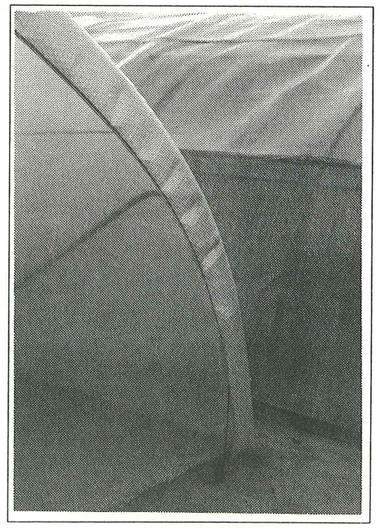


Figure 5. Fixing film at the end of the frame

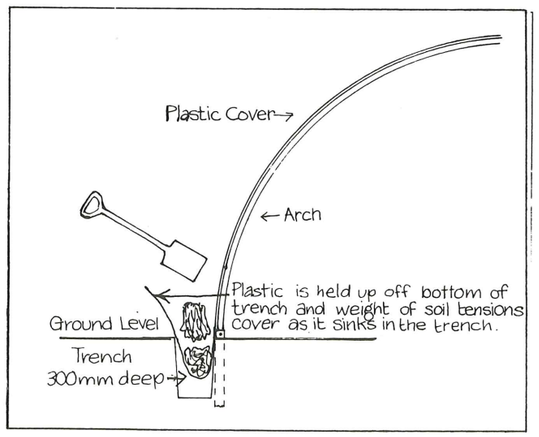


Figure 6. The plastic sheeting is stretched over the tunnelhouse frame by the weight of soil on the sheeting, which is placed into a 300 mm deep trench at the perimeter of the tunnelhouse

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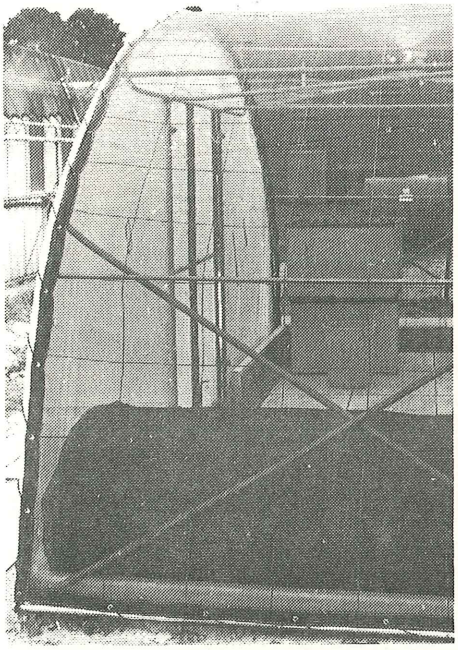

Figure 7. Fastening prefabrication shade-cloth covering to the tunnelhouse frame

Other materials

Materials other than steel piping can be used to build tunnelhouses. Fibre glass rods have been used extensively to build greenhouses in countries with similar climatic conditions to Western Australia (see Figure 8). Many more arch supports 1.7 m apart are necessary if using fibreglass rods or lighter gauge steel piping. Bamboo rods and laminated timber battens have been used, but they need lagging to prevent damage to the film.

Materials required

- 14 arch support tubes 75 cm long (10.5 m of 32 mm galvanized pipe)
- 7 arches 10.2 m long (71.4 m of 20 mm galvanized pipe)
- 7 transverse braces 4.85 m long (33.95 m of 20 mm galvanized pipe)
- 12 corner braces 3 m long (36 m of 20 mm galvanized pipe)
- 2 end frames (9.8 m of 20 mm galvanized pipe)
- 4 doors 2.1 m high by 0.8 m wide (34.4 m of 20 mm galvanized pipe)
- 3 longitudinal braces 15.2 m long (45.6 m of 20 mm screwed and socketed galvanized pipe)
- 34 Downee 20 mm tees cat. no. T2020
- 8 Downee 20 mm crossover gate hinges cat no. H2020
- 37 galvanized cuphead bolts and nuts, 64 mm x 8 mm
- 14 high tensile hexagon head bolts and nuts, 51 mm x 6 mm
- 4 sheets of 2.1 m long standard corrugated fibre glass sheeting
- 22 metres of No. 20 nylon blind cord
- 23 metres of 150 micron, 11 m wide UV stabilized polythene sheeting (including material for ends)

Extra material for shade cover

- 2 longitudinal braces 15.2 m long (30.4 m of 25 mm by 1.6 mm galvanized ERW tube)
- 2 longitudinal braces 15.2 m long (30.4 m of 19 mm by 1.6 mm galvanized ERW tube)
- 1 roll of roof safety mesh, 60 m
- 50% shade-cloth cover fabricated to fit 15.2 m by 9.6 m
- 28 galvanized cuphead bolts and nuts, 65 mm x 8 mm

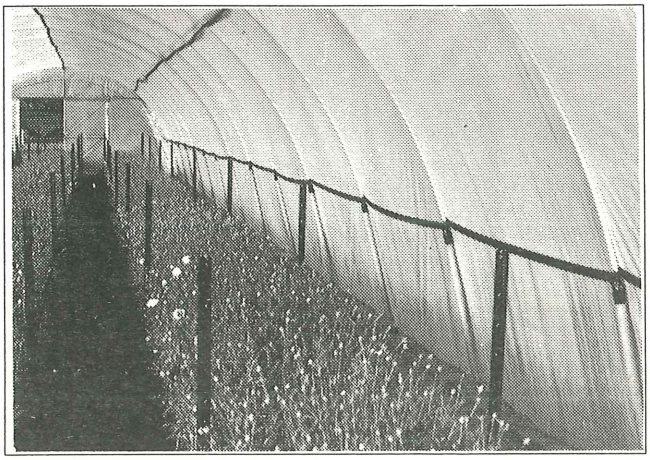

Figure 8. Fibreglass rods can be used instead of steel piping for the frame

Sundries

Gutter bolts; pop rivets; PVC insulation tape; door catches and bolts; steel pegs; 13 mm rod; 15 mm pipe; approximately 20 m of 25 mm black polythene pipe and about 70 m of 2.5 mm galvanized fencing wire.

Cost of materials - mid 1989

	$
Galvanized piping	917
Downee tees	44
Downee hinges	27
Fibreglass sheeting	73
Nylon cord	7
Bolts, nuts	29
Sundries	40
Total	$1137

Additional cost for plastic:

Fabricated cover 11 m wide by 16.4 long Infrasol® (sold as 40 m roll in 11 m or 14 m width; cost of 40 m x 11 m roll = $475.60)	$273
	or
Rheem Solarweave® (sold as 100 m x 1.8 m rolls, $317/roll)	$510

Estimated time for fabrication and erection (levelled site): two men for 3.5 to 4 days.

Extra cost to fit shade-cloth

Galvanized piping	241
Cuphead bolts and nuts	18
Safety mesh	109
Shade-cloth, 50% woven	518
Total	$886

Note: These quotations are not an endorsement of the products; they are examples only. A wide range of plastic films is available; the cost of the films may be less or more than those above. The life of these films also varies considerably and is usually correlated with price.

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