

MISCELLANEOUS REPORT NOR-Y-1

C. E. Edey (1972)

SEMI-PERMANENT GREENHOUSES FOR CONIFEROUS CONTAINER PRODUCTION.

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SEMI-PERMANENT GREENHOUSES FOR  
CONIFEROUS CONTAINER PRODUCTION

by

C. E. Edey<sup>1</sup>

INTRODUCTION

Plastic semi-permanent greenhouses meet the needs of a fast expanding demand for coniferous container seedlings. The fact that their construction is relatively cheaper than permanent greenhouses and that they may occupy space designated for future development makes them desirable. Disadvantages tend to be limited to possible greater damage of polyethylene materials to weather and that semi-permanent greenhouses tend to have less aesthetic value due to their type of construction. However equal quality stock can be reared in plastic semi-permanent greenhouses as that produced in permanent greenhouses.

For the past three years, the Northern Forest Research Centre has operated a 12'x50' semi-permanent greenhouse at the Oliver Provincial Nursery. It was originally constructed as a low cost greenhouse to be operated year round for the production of coniferous seedlings in research. Modifications of temperature, lighting, and moisture present little problem when applied to the entire greenhouse or to small sections. It is currently used as a production unit in conjunction with

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two similar greenhouses operated by the Nursery. Production capacity of one house would be 160 BCFS/CFS styro blocks per production run.

#### PURPOSE

It is the purpose of this report to present the basic material requirements and "ball park" costs for the construction of similar semi-permanent greenhouses. Also included are the material required for the construction of a 32'x60' semi-permanent archrib greenhouse, and a comparison of covering materials.

#### Construction of 12'x50' Greenhouse

Construction consists of a three-foot side wall using 2"x12" fir planks, the planks being anchored with reinforcing rods. The top of the wall is drilled at four-foot intervals to receive the 3/4"-thick walled conduit forming the framework for the roof. The conduit rises 28" from the wall, then bent to form the roof. Using standard conduit couplings, the roof frame is joined at the peak. Vertical conduit is applied on each side of the peak bend and just below the bends above the wall. This framework is sturdy enough to support a double layer of polyethylene and will also withstand a certain amount of snow accumulation.

Polyethylene of .6 mm thickness is applied over the framework and secured to the fir wall. A second layer of Griffolyn Virsatarp is then applied using either 2"x2" or taut wires to maintain an insulating air

air space between the two layers.

Heating requires a minimum of 140,000 B.T.U. input forced-air furnace for year around use. By using an 18" polyethylene duct suspended below the ridge, good air flow and even heating can be maintained. Consideration of installing a spray type humidifier on the furnace would be a great asset in maintaining higher humidity in the greenhouse.

Ventilation involves the installation of at least one 24", 2000 CFM extraction fan. Located at the opposite end from the extraction fan should be louvered fresh air intakes, preferably ducted to supply uniform air intake throughout the greenhouse.

Adequate lighting is provided using 200 watt incandescent light bulbs. These should be located three feet apart and no higher than three feet above the stock to be grown. Installation of time clocks facilitates regulation of the photo period as required.

Benches are constructed using 2"x4"s for the main forms. The bench top should be constructed with 1"x4" boards while leaving a one-inch space between the boards. Other materials such as plywood could be used, however, a solid bench does not allow drainage. Inadequate drainage does not allow roots to be "air-pruned" when using the BCFS/CFS styroblock.

The greenhouse floor surface should be elevated above the surrounding area to provide good drainage of excess water away from the greenhouse. A layer of crushed, washed gravel on the walk ways and under the benches prevents the accumulation of excessive water.

It may be advantageous to include time clock controlled water solonide valves to provide a misting system to water stock on a regular basis or to regulate humidity.

#### DISCUSSION

With the increasing demand for container grown coniferous stock, the possibilities of semi-permanent greenhouses should not be overlooked. They are only a fraction of the cost and time to construct compared to permanent greenhouses.

In the case where one central area produces the entire stock for a large region, it would be possible to locate semi-permanent greenhouses closer to the required area thus relieving some of the pressures from the main nursery. This would require a short course in the handling and production of stock for local greenhouse men. However, this may prove more economical than providing expansion at one central location.

Not to be overlooked is the fact of disease spread in seedlings. Control of pathological problems should be dealt with in the initial stages of tube filling and seed sterilization. However, should problems arise, they are much easier to control within smaller greenhouse units.

Appendix 1

<u>Greenhouse Materials (12'x50')</u> Estimate			Cost
Plates	6	2x4x16'0	
Stud wall 4'0	15	2x4x16'0	\$ 38.00
End wall studs	5	2x4x16'0	
Gussets	5	4'x8'x $\frac{1}{2}$ " Fir	42.50
Sheathing endwalls	8	4'x8'x $\frac{1}{2}$ " Fir	68.00
Door	1	1 3/8"x3'0x6'8"	20.00
Lockset and hinges			15.00
Straps (backing for lights)	6	1x4x16'0	5.00
Fresh air intakes	2	4'x8'x3/4" Fir	21.00
Legs and joists (benches)	18	2x4x16'0	26.00
Slats (bench top)	50	1x4x16'0	40.00
Incandescent outlets	30	Includes wire panel	210.00
Furnace (Min. 140,000 BTU input)	1		300.00
Extraction Fan (24" 2000 C.F.M.)	1		200.00
Circulation Fans (12")	2		100.00
Thermostats	2		100.00
Ductwork			200.00
Water lines (50 ft.@ .20/ft.)			20.00
Time Clocks (Paragon 4001-0)	2		60.00
Gravel (washed and crushed)	5 yards		30.00
Estimated labour carpenter & helper			450.00
			<hr/>
			\$1,945.50

Appendix 2

Coverings (12'x48' Greenhouse)

A. Plastic

3/4" rigid conduit	460 ft.	\$185.00
Griffolyn Virsatarp	24'x50'	75.00
Polyethylene 6 ml.	20'x50'	50.00

Total \$310.00

Heat loss single layer 1.18 BTU/hr./ft<sup>2</sup>/°Temp.difference.

Double layer with air space .55 BTU/hr./ft<sup>2</sup>/°Temp.difference.

B. Fibre glass

Rafters 8.0 ft.	25	2x4x16'0	
Ridge	3	2x4x16'0	40.00
Fibre glass 6 oz. Flat clear		1000 ft.sq.	380.00

Total \$420.00

Heat loss 1.15 BTU/hr./ft.<sup>2</sup>/°Temp.difference

C. Glass (20'x20'x1/8 panels)

Rafters 8'0	30	2x2x16'0	27.00
Ridge	3	2x2x16'0	133.00
"I" beam (2 1/4"x3")		140 ft.	133.00
Channel iron (3")		100 ft.	60.00
Glass (20"x20"x1/8" double diamond)			290.00

Total \$643.00

Heat loss 1.13 BTU/hr./ft.<sup>2</sup>/°Temp. difference

Header House

20'x40'x8'0	@ 7.00/ft. <sup>2</sup>	\$5,600.00
Benches		100.00

Appendix 3

Arch rib Greenhouse (32'x60') Estimate. Dept. of Public Works

Concrete curbing	29	6"x6"x8'0	\$ 144.00
Dowels (iron)	48	5/8"x18"	24.00
Gravel	15 yards		90.00
Plates	25	2x6x16'0 Fir	38.75
Archribs	34		400.00
Studs & ribbons	70	2x4x16'0 Fir	105.00
Polyethylene	4000 ft <sup>2</sup>	Approx. @ .09/ft <sup>2</sup>	360.00
Strips	70	1/2"x1 5/8"	23.50
Doors	2	3'0"x7'0"x1 3/4"	60.00
Frame	2	2x6x16'0	4.70
Hardware for doors			70.00
Plywood	28	3/8"x4'x8'	168.00
Plywood gussets	5	5/8"x4'x8'	35.00
<u>Benches:</u>			
	30 per bench	2x4x16'0	
Frame	150	2x4x16'0 Fir	220.00
Deck	250	1x4x16'0 Fir	175.00
Nails	50 pounds	2" coated	10.00
"	20 pounds	3 1/2" "	5.00
<u>Labour:</u>			
Carpenter	1	64 hrs. @ 5.50/hr.	352.00
Helpers	2	128 hrs. @ 4.30/hr.	550.40
<u>Electrical</u>			
Lights	100	Pin type sockets	25.20
Extraction Fans	2	36" 1/3 hp.	325.00
Cooling Fan	1	24" 1/3 hp.	120.00
Wire & accessories			150.00
Thermostats			200.00
Labour		120 hrs. @ 6.00/hr.	720.00
<u>Heating:</u>			
Furnaces	2	180,000 BTU input counter flow	670.00
Install ducts & heating system			580.00
Total			\$ 5,625.55



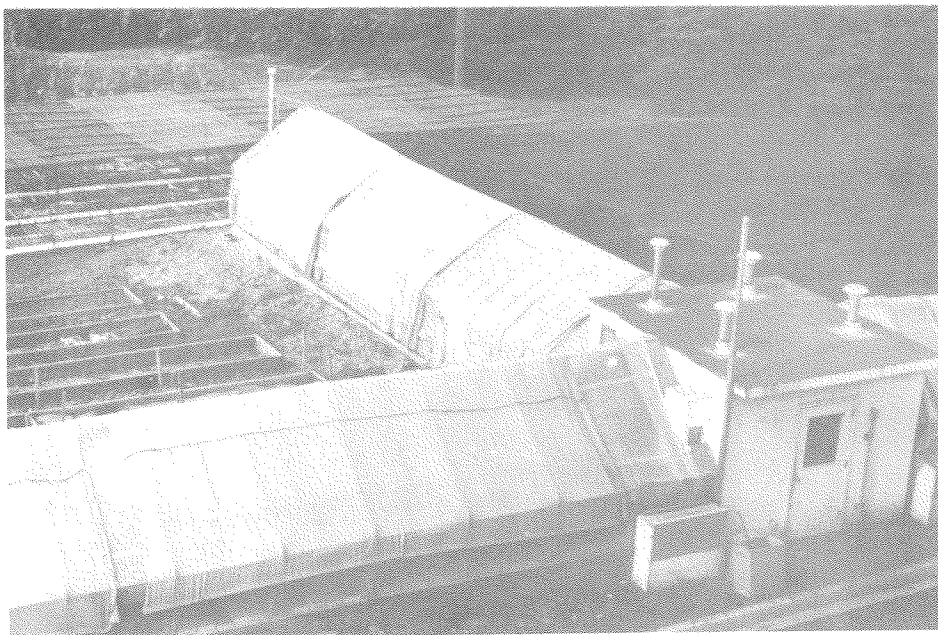
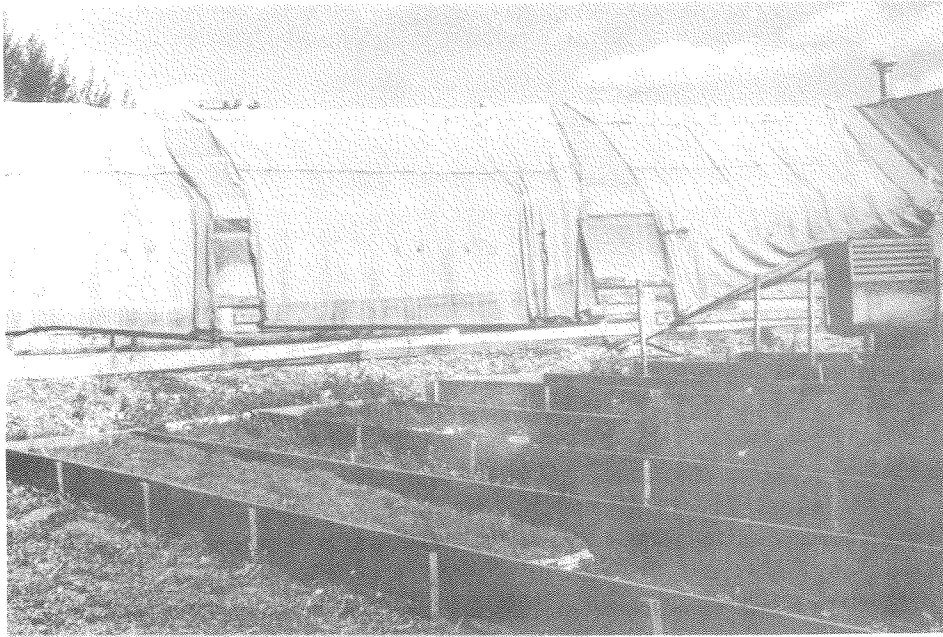
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- Wiebe, John and R.E. Barrett. Plastic Greenhouses, Ontario Dept. of Agric. and Food., Pub. 40.
- Gubbels, Gerard H. How to build a plastic crop shelter or greenhouse. Can. Dept. Agric., Res. Branch, Publ. 1337.
- National Greenhouse Co., Greenhouses Parts Supplies Accessories, Pana., Illinois, 62557.

South exposure of greenhouse. 7 1/2 oz. burlap is used as shade cloth with a hem sown in at top and bottom. Conduit is inserted in the hems to provide a means to anchor the shade along the ridge and bottom. When the shades are not required they may be rolled up or pulled to the other side.

The extension of three semi-permanent greenhouses from a central headerhouse. This size of headerhouse provides room only for forced air heating and mechanical control units.

Note positions of louvered fresh air inlets. Extraction fans are located at the opposite end from intakes.



Longitudinal view of 12'x50' greenhouse showing:

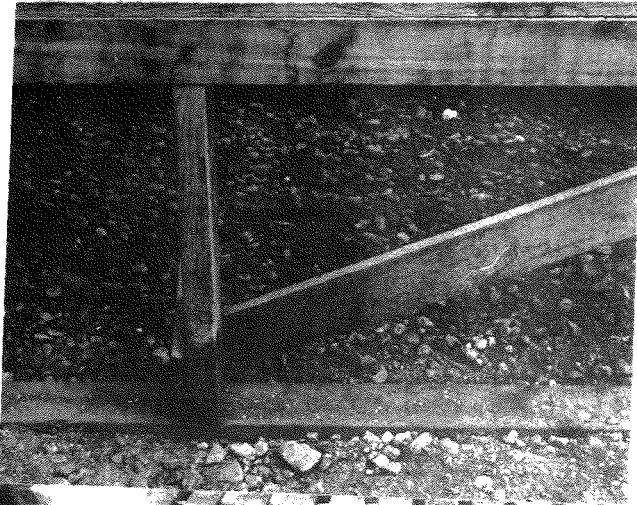
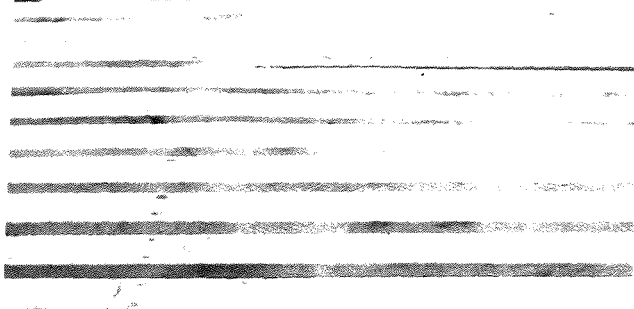
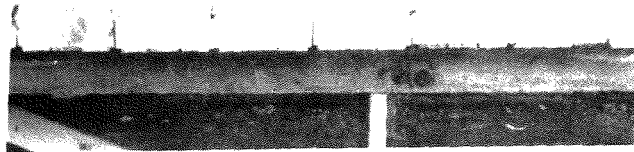
- bench location, 4-foot wide bench with 1"x4" board top,
- additional second tier bench on right to increase production by 50%,
- lighting location of incandescent fixtures and modification for fluorescent lighting,
- roof frame construction of 3/4" rigid conduit on 4-foot centres,
- double layer polyethylene and grifolyne roof using 2x2 spruce as spacing between layers,
- two-foot poly-tybe heating duct suspended underneath the ridge.  
Outlet holes are added at time of installation, two-inch diameter on two-foot centres located just below centre line. This gives an even distribution of heat downwards along roof.
- additional space heater at rear of greenhouse as originally a 90,000 BTU furnace was inadequate.



Bench construction using 2"x4" fir and 1"x4" spruce.

Both of these benches have been extended to accommodate additional BCFS/CFS trays. Original bench width was 4 feet.

The use of 1"x4" bench material allows essential drainage encouraging air root pruning when production includes the BCFS/CFS styro blocks or similar tubes.

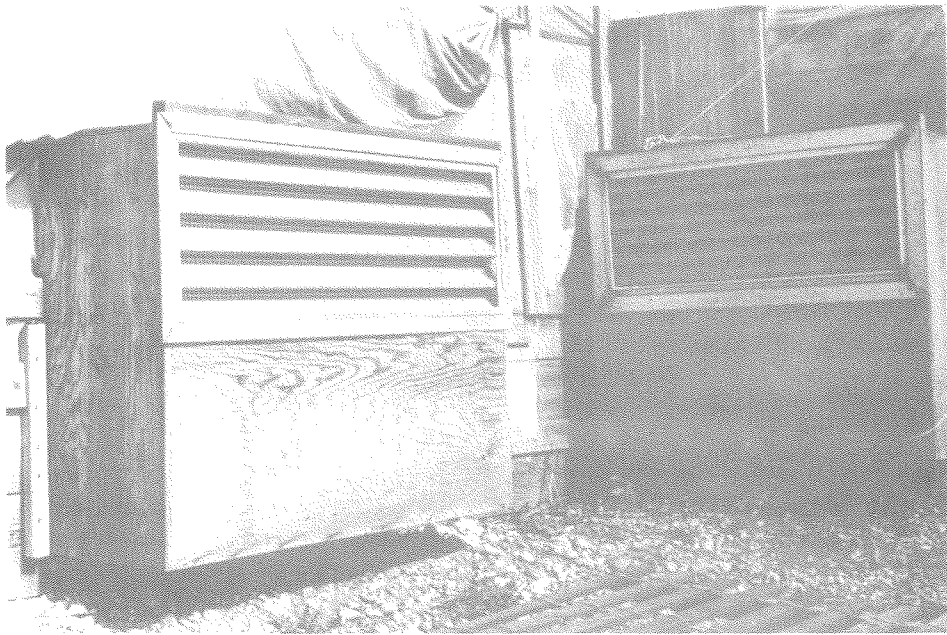
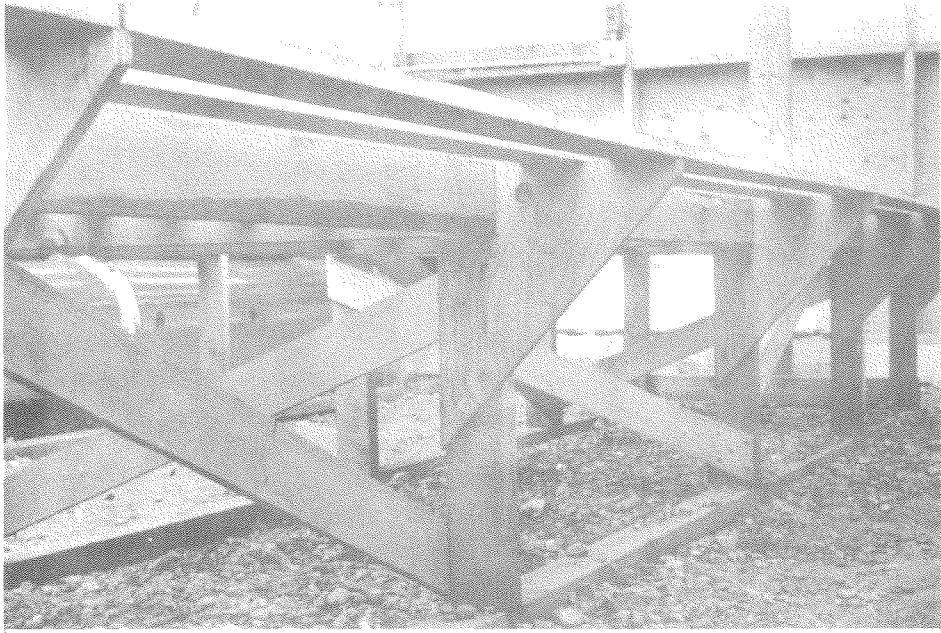


Use of 3/4" gu plywood gussets for extending the width of the benches.

Fresh air intakes constructed of 3/4-inch plywood. Location of outside vent on upper half of box with a fixed louver intake. Bottom half of intake extends into greenhouse and may have adjustable louvers or plywood door to regulate the size of the fresh air intake.

Consideration should be given to the distribution of fresh air evenly along the entire length of the greenhouse rather than "dumping" at one location.

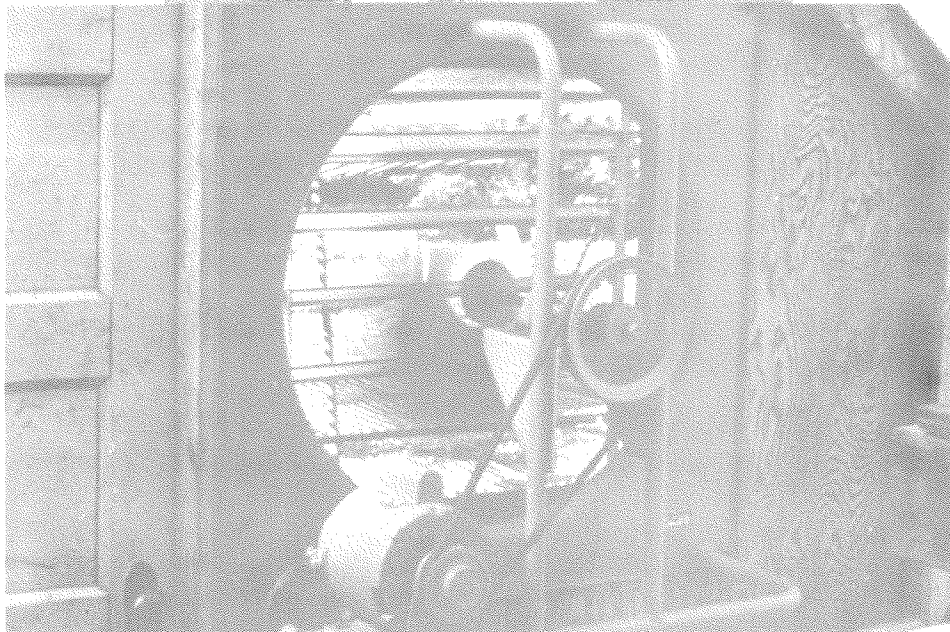
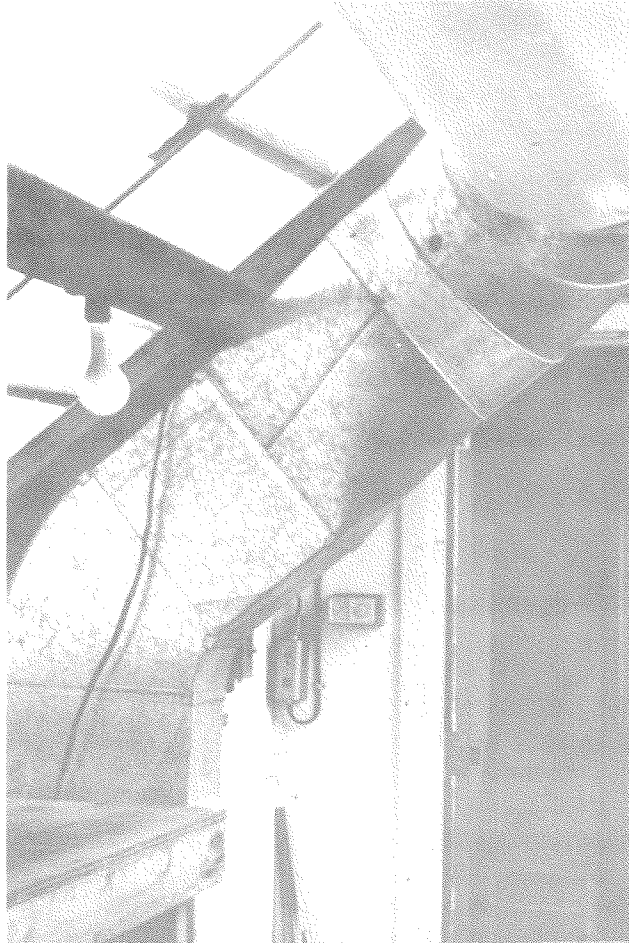




Hot air plenum rising from furnace to below ridge for the poly tube take-off.

Location of thermostats, one day-night for heat control and one to control the extraction fan. Thermostats should be located near the centre of the greenhouses and in the main area of air flow for proper regulation of greenhouse temperatures.

Location of 24" diameter, 2000 CFM extraction fan at opposite end of greenhouse from fresh air intake.



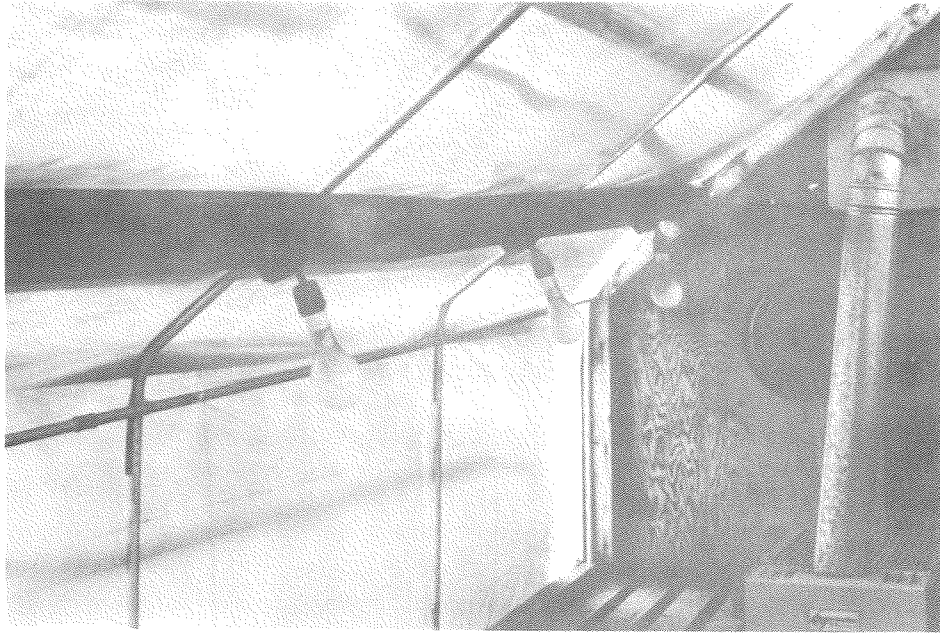
Construction of roof support using 3/4" rigid conduit at 4-foot centres. Bottom ends of conduit are inserted into holes drilled into 2"x12' fir planks forming the lower sidewalls. Lengths of conduit are joined using standard conduit couplings. Horizontal conduit bracing is secured by aluminum screws to the vertical roof supports. The ridge has two parallel lengths of conduit bracings fastened one on each side of the peak.

The installation of 200-watt incandescent bulbs at a height of three feet above the bench and at 3-foot intervals.

Installation of 12-inch circulation fans, on opposite sides and ends of the greenhouse greatly assist in maintaining uniform temperatures throughout the greenhouse.

The addition of a space heater should not be required if adequate heat is installed originally. However, if required, provide adequate circulation.

Addition of fluorescent lighting.

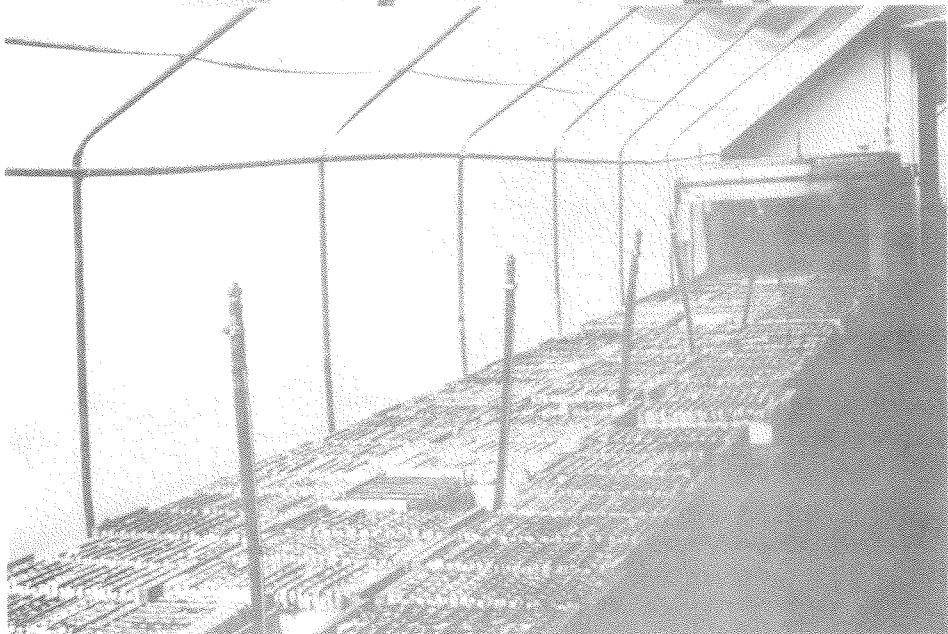
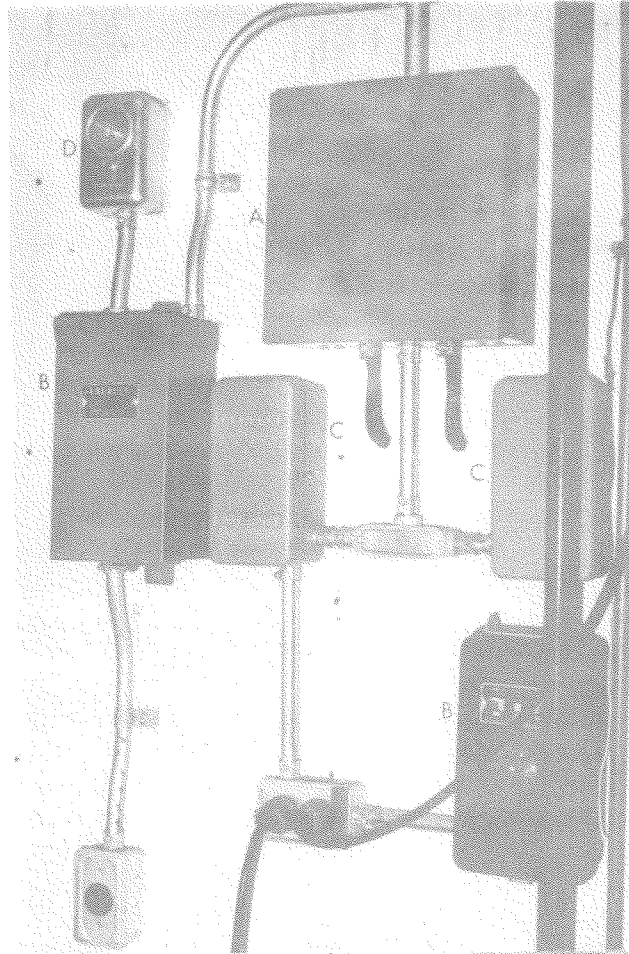


Controls for lighting and misting.

- A. Two circuit relays for incandescent lights.
- B. Paragon 1015-ORS time clock. 24-hour with 15-minute intervals. Also it has a 7-day cycle allowing the elimination of programmed daily cycle on specific days. One combined with D for the control of masters and one for control of fluorescent lighting.
- C. Paragon 4001-0 24-hour time clocks operating circuit relays (A) for incandescent lights.
- D. Paragon JW10-0, 10-minute cycling clock for control of misting duration. May be set from 15 seconds to 10-minute cycles.

Installation of No. 603 mist nozzles at 4-foot intervals.

Adequate for maintaining moisture during germination and growth.

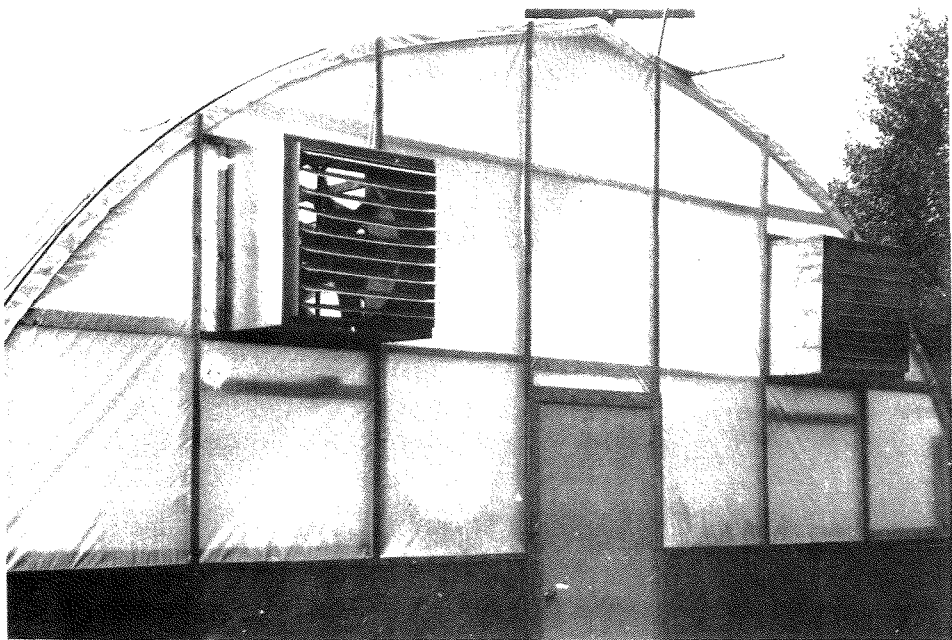
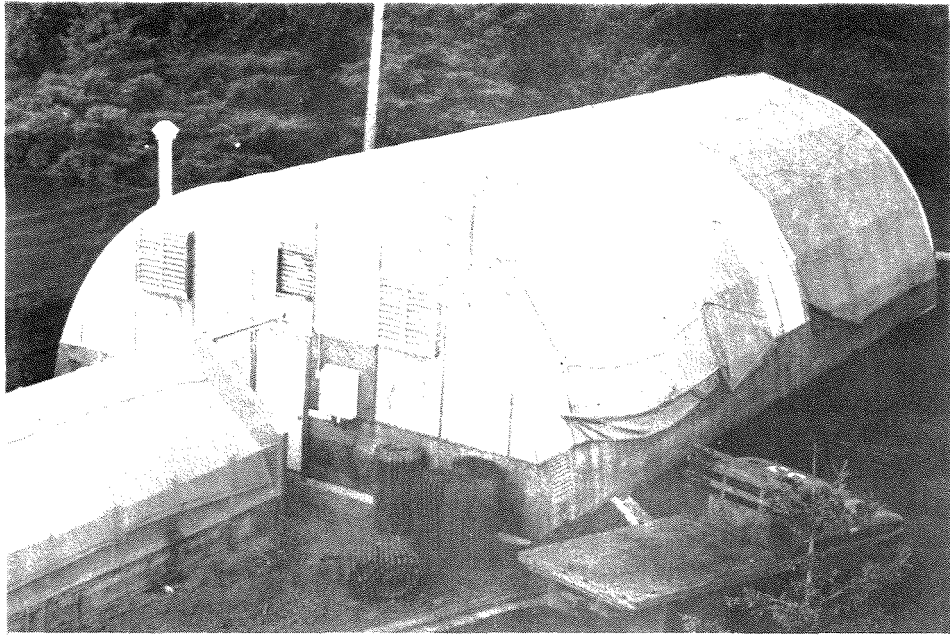


32'x60' Semi-permanent, arch rib greenhouse.

- heated with two counter flow, forced air furnaces, 180,000 BTU input per furnace,
- three fresh air intakes located 8 feet above ground,
- use of 7 1/2 oz. burlap for shades.

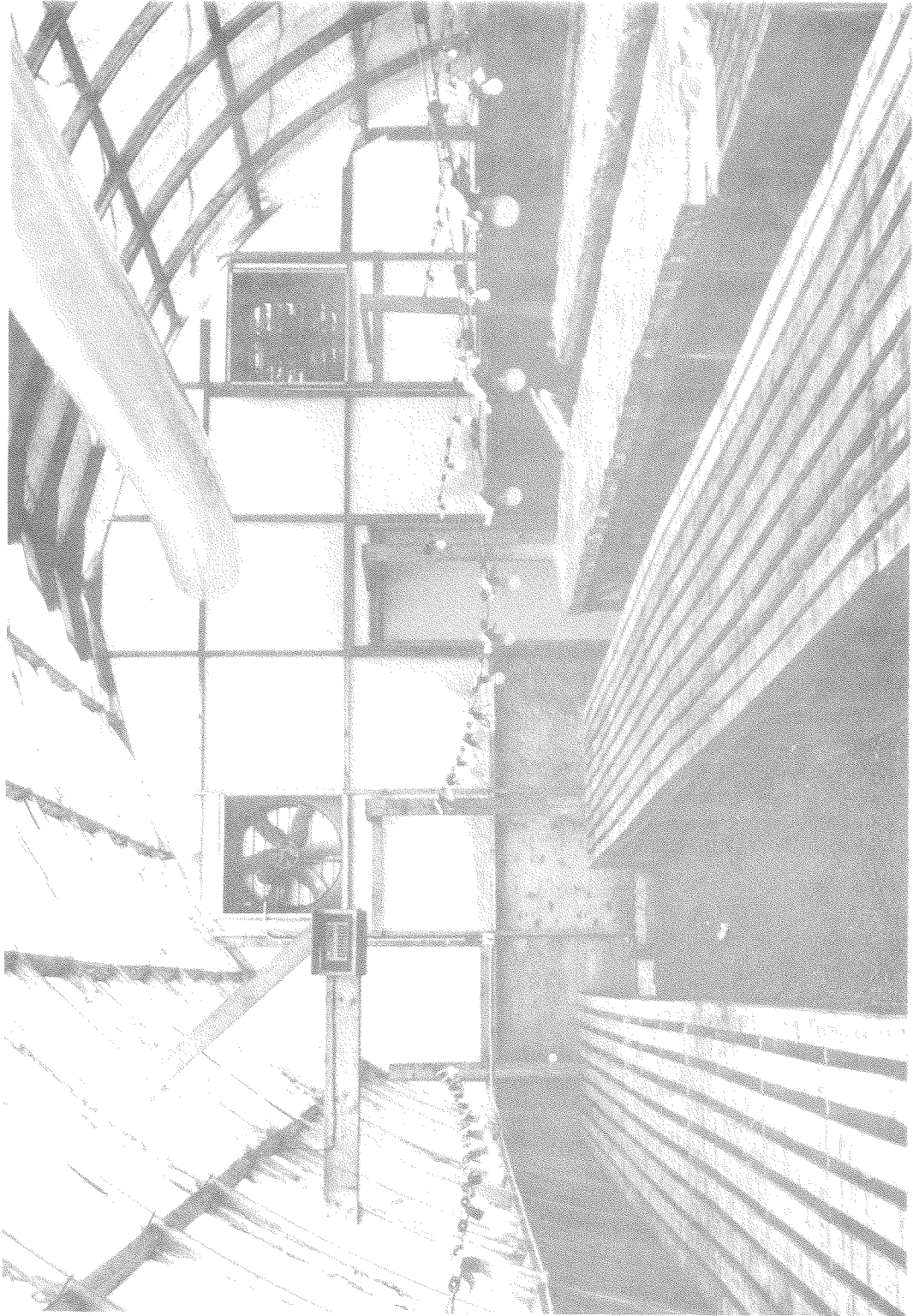
Two, 2-speed, 36-inch extraction fans operating from separate thermostats. Locations of extraction fans on the opposite end from intakes.





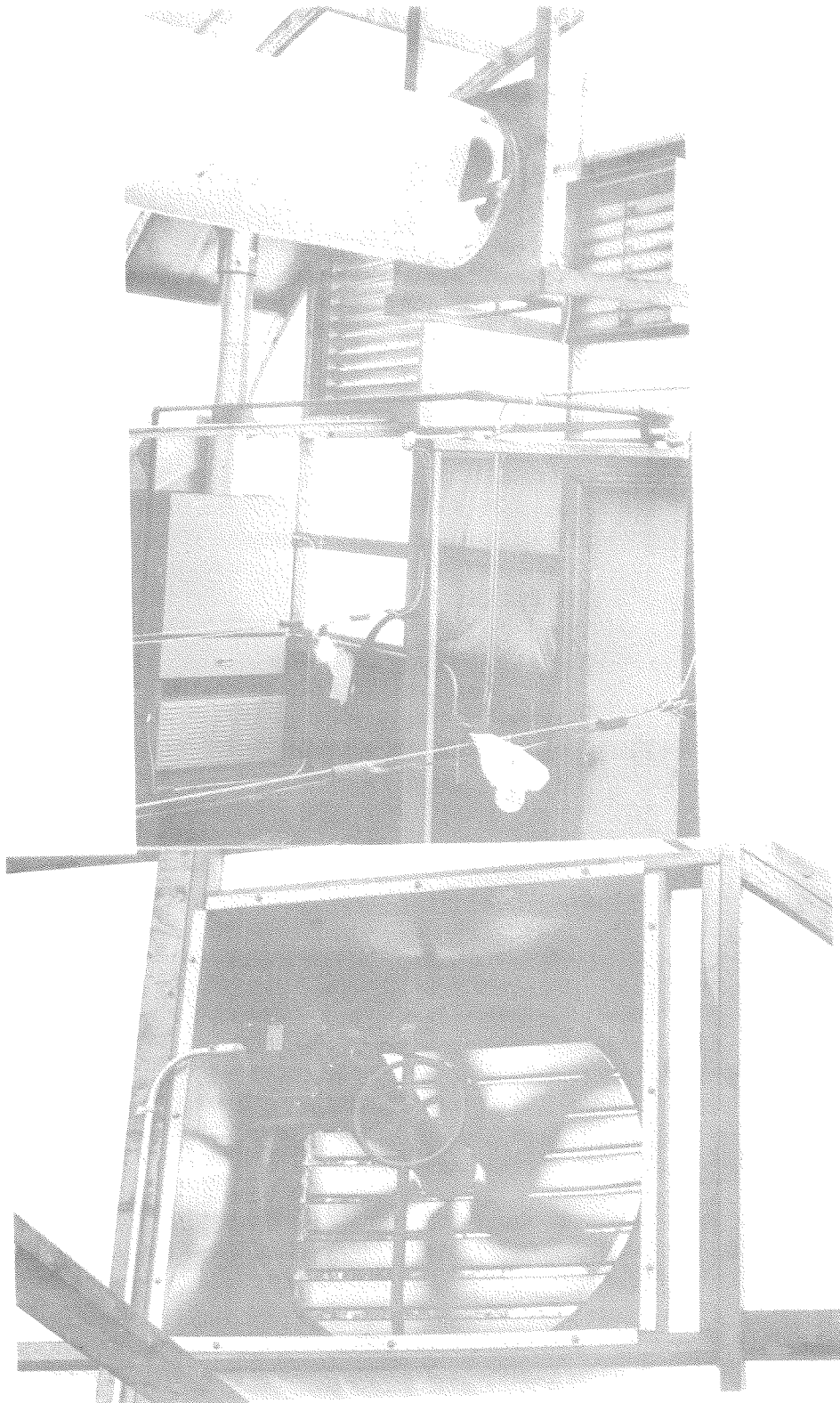
Arch rib greenhouse.

- five benches, 2x4 construction with 1"x4" tops.
- lighting consists of incandescent 60-watt bulbs at 3-foot centres. These are a pin socket which clip onto the wires supported by a taut galvanized wire. However this is inadequate lighting and the socket is not waterproof.
- roof support structure consists of 32' arch ribs at 4-foot centres and 2x6 sway bracing.
- roof covering of griffolyn "fulcon" plastic. An inside layer of polyethylene could be added.
- heating furnished by two 180,000 BTU counterflow natural gas furnaces. Polyethylene heating ducts are located one under each of the outer benches.
- ventilation consisted of three louvered intakes, polyethylene distribution duct and two independent thermostatically controlled extraction fans.
- crushed, washed, gravel floors for drainage.



Polyethylene duct with fan to assist even air movement throughout the greenhouse.

Operation of two-speed extraction fan.



### Header House

Essentials to a header house include soil bins and work benches. Floor drains with a soil trap facilitate cleanup of work area.

Steam autoclave for sterilizing container mix. For production purposes surplus mattress sterilizer would be required.

