

Home Greenhouse Construction

Presented by

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Goal

- OPTIMUM GROWING
CONDITIONS FOR PLANTS
- LIGHT AND TEMPERATURE

STRUCTURE

Max. light entrance and Min. shadow

- Support: *factors to consider*
 - Weight of Covering
 - Accumulation of Ice / Snow
 - Strain of Wind

Structure Material

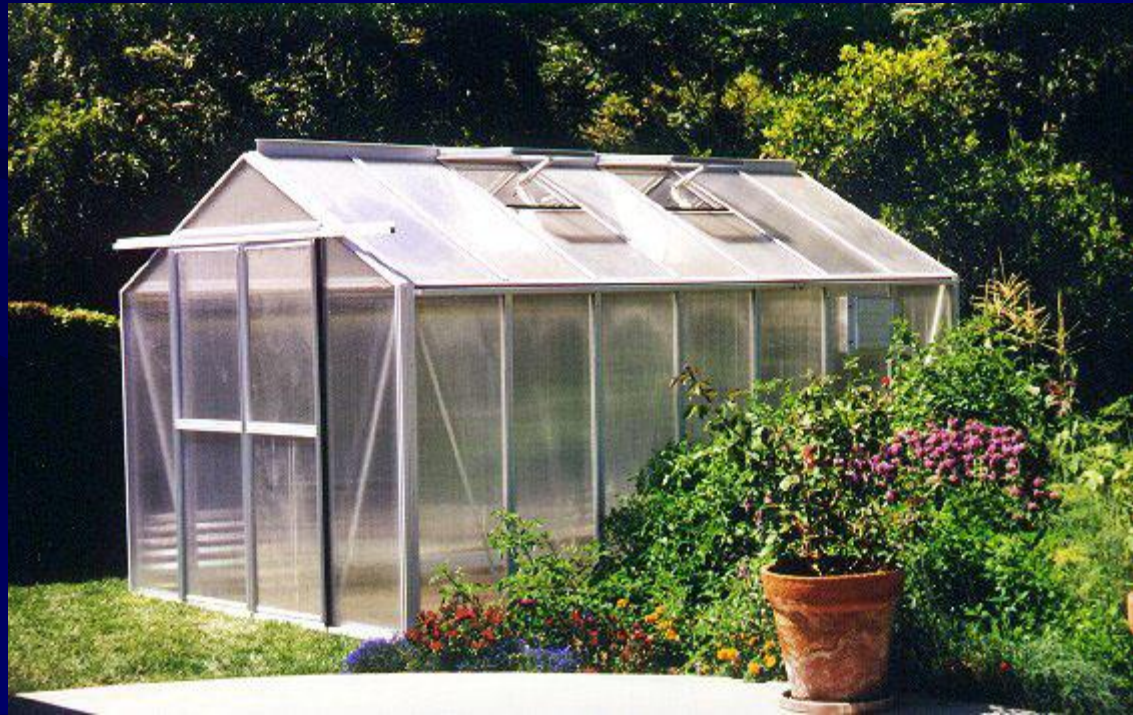
- **Wood:** Redwood, Cypress, Cedar
- **Metal:** Steel, Iron, Aluminum
- **PVC Pipe:**
Inexpensive for small structures



COVERING

FACTORS TO CONSIDER

- AMT OF LIGHT TRANSMISSION
- STRENGTH
- LIFE OF MATERIAL
- INSULATING
- HEAT LOSS
- COST



COVERING PRODUCTS

- ACRYLIC
- GLASS
- POLYCARBONATE
- FIBERGLASS
- POLYETHYLENE FILM

FOUNDATION

- Should be anchored and level to a foundation
- Concrete, Concrete Blocks, Pressure Treated Wood
- all should be at least 24” below the ground

Flooring

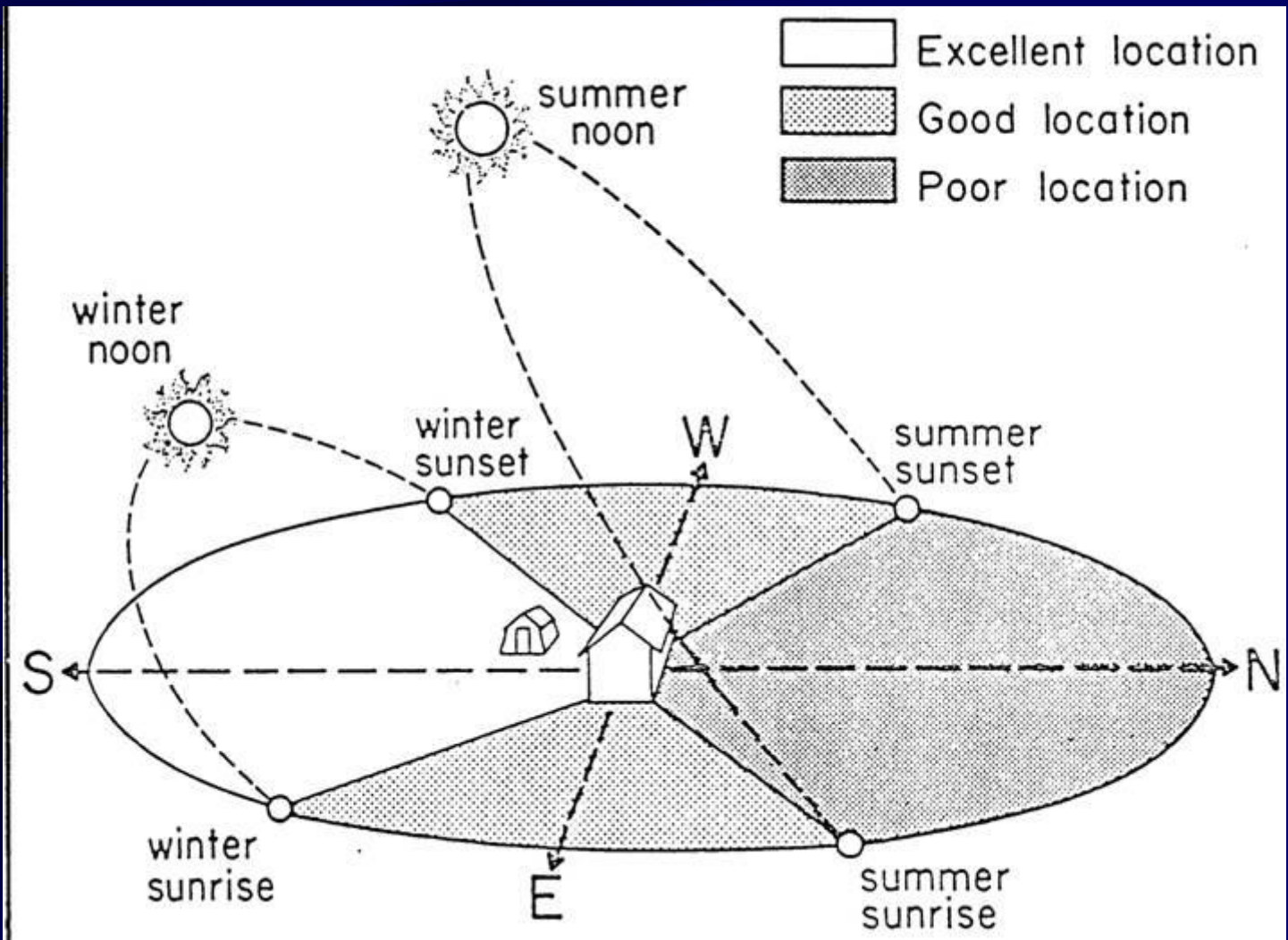
- Under Growing Area
 - **NEED WATER TO DRAIN**
 - 4” Thick Gravel, Pea Stone, Porous Concrete
 - Ground Cloth
- Walkways
 - Brick, Flagstone, Concrete, Porous Concrete

Roof

- Slope of Roof
 - Too Steep = Creates a mirror effect
 - reflects vs transmits light
 - Too Flat = Leaks, Ice and Snow Buildup
- Roof Pitch/Slope
 - Approx 27-32 Degree Slope

Location of Greenhouse

- Attached
 - Most Desirable:
 - **South or Southeast** Side of the House
 - Least Desirable:
 - North Side of House
- Freestanding
 - **East- West** greenhouse will transmit about 25 % more light than one situated north-south



Site Considerations

- Amount of Sunlight (Min. of 6 hours)
 - if less plan to supplement w/ artificial light
- Nearby Trees/Buildings
 - shadows: created by objects 60' away in winter
 - west deciduous trees
- Direction/Force of Prevailing Winds
 - increase wind increase heating cost
 - reduce wind speed: 15' away from greenhouse
 - Plant Hedge (Avoid Dense Plants)
 - Slat-Type Fence (not solid)

Drainage

- Surface:
 - Slope Ground Away from site
- Underground:
 - If drainage is problem: lay 4” perforated plastic pipes to carry excess water away

Other considerations

- Source of **water, electricity, and fuel**
 - Electricity: Greenhouse less than 5,000 sqft requires:
load of 60 AMP and Current of 240 Volts
- Appearance and blending into total landscape
- Location of pavement and other **heat absorbing material**
- Building **codes, zones, permits**
- How many **sqft of growing area**
- Can you **expand**



SIZE OF GREENHOUSE

- WIDTH
 - Wide as possible for easier to increase the length
- LENGTH
 - Best determined by # of plant you want to grow
 - e.g.: 6” pot requires 1 sqft of growing space
- HEIGHT
 - height should be equal to the eave height plus $\frac{1}{4}$ the width of the greenhouse

Types of Greenhouse Structures



The Freestanding Northern Light Greenhouse.



The Freestanding American Harvest Greenhouse.



Attached Greenhouse Structures

- close to electricity, heat, water
 - Lean-To:
 - limited space: width < 12 feet, length of house
 - limited sunlight, ventilation



ATTACHED GREENHOUSES

– Even Span:

- attached to house by one gable end
- greater flexibility and room

– Solarium:

- one room in the house



FREESTANDING

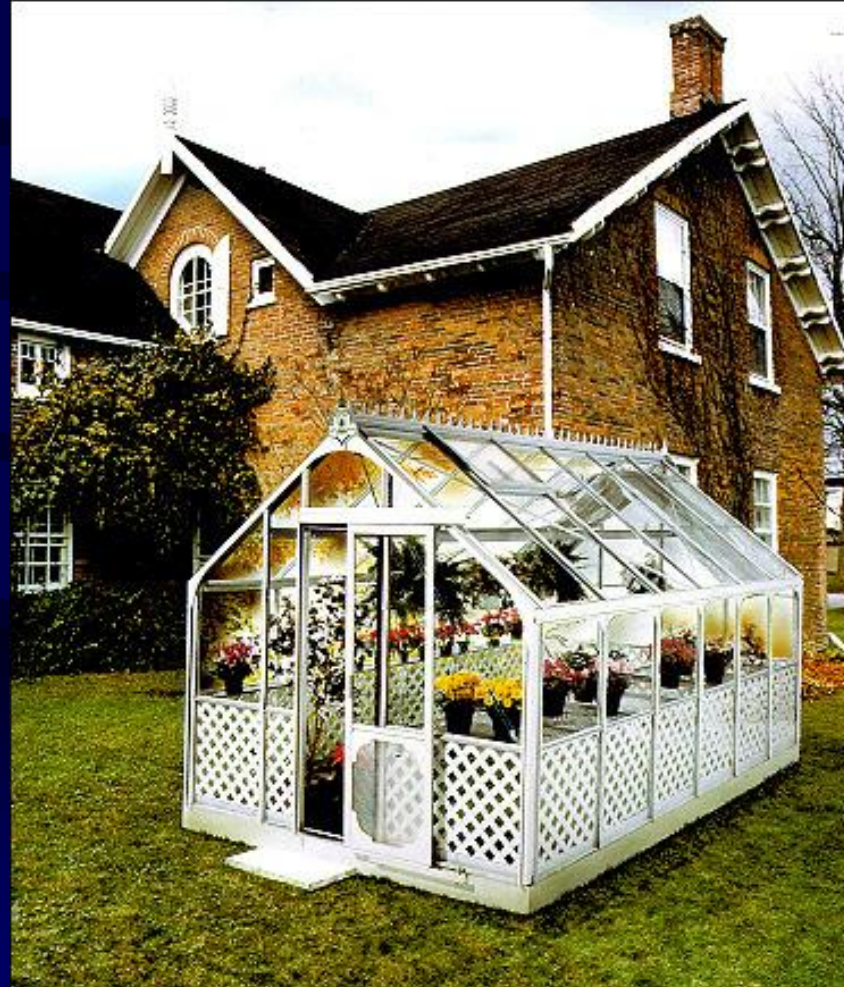
- Advantages:
 - separate structure more easily adapted to ideal location, maximum sunlight, space, flexibility



- A-Frame



Rigid Frame, Even Span & Quonset



Coldframe

- NO HEAT EXCEPT SUN

– USED FOR:

- Starting Seeds (Bottom Heat)
- Hardening off Plants
- Propagation of Woody Ornamentals



Heating

- Night Temp: 55-65⁰ F (min 40 - max 85⁰ F)
- Max. Day Temp: 10-15 degrees higher
- Consider:
 - Fuel Available
 - Size of Greenhouse
 - Operational Cost
 - Covering & # of Layers
 - Site of Greenhouse: Wind
 - Requires Min. Maintenance / Auto Operation

- **Locate Thermostat** at plant height w/ shade over top to avoid false readings
- **Vented Heaters:** Down drafts caused by chimney not high enough to clear ridge of g.h. (at least 2') open doors & vents can cause draft
- **HEATING SAFETY MARGIN:**
 - Rule of thumb: for est. heat loss 1.2 BTU per hour for each degree of temp differential per sqft of exposed surface

Table 1. Heat Requirements For Single Layer Plastic Or Glass Covering*
(1.2 BTU/Hr.sq.ft)

Minimum Inside Temperature °F	BTU's per hour per square foot of exposed surface when the lowest outside temperature is (°F)			
	30	20	10	0
40	12	24	36	48
45	18	30	42	54
50	25	36	48	60
55	30	42	54	66
60	36	48	60	72
65	42	54	66	78
70	48	60	72	84

*Add 20 percent for windy location. For double layer plastic covering, multiply the table values by 2/3.

Types of Heating

- **Attached Structures:** Extension of Home Heating System
 - **Hot Water:** Extend Pipes into Greenhouse
 - **Hot Air:** Add Ducts and Thermostats
 - **Open Door and Fan Blow in House Heat**
- **Free Standing Structures:**
 - **Space Heaters w/ Electric Fans**
 - **Low Cost for Small Greenhouse**
 - **Force Hot Air Heaters**
 - **Heater w/ air circulation system & chimney**
 - **PLASTIC PUNCHED TUBE**
 - **HORIZONTAL AIR FLOW FANS**

- **Hot Water or Steam Heat**

 - Piped in Greenhouse

 - More popular heating w/hot water in localized benches

- **Electric Heaters**

 - Overhead heating + Soil heating cables
 - provides a localized plant environment which allows plants to thrive when surrounding air is lower than normal

- **Solar Heating**

 - Use of black painted drums filled w/water to absorb heat & release it back into the environment

VENTILATION

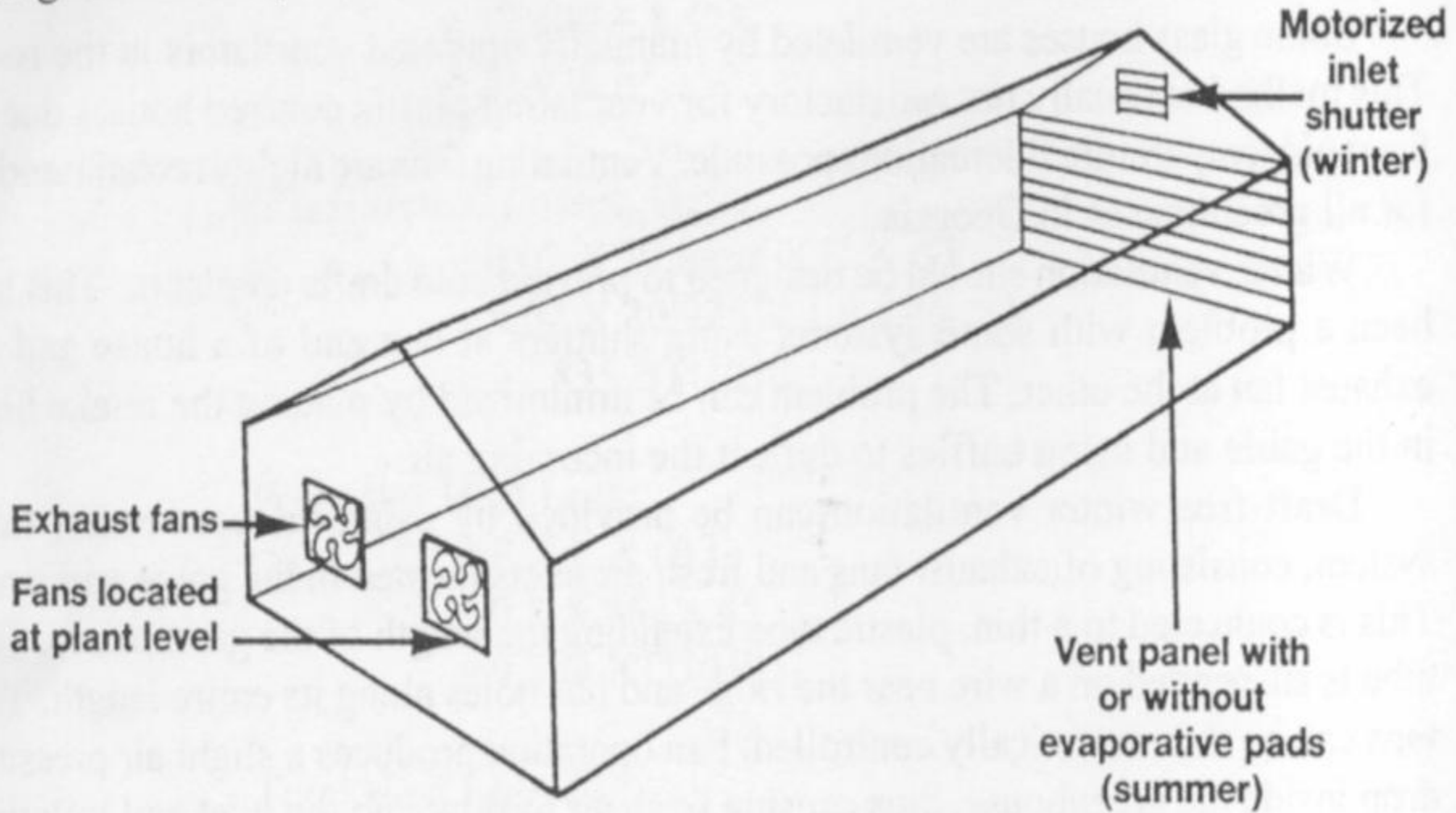
- VERY IMPORTANT FOR AIR MOVEMENT
 - PLANTS GROW BETTER WHEN AIR IS CONTINUOUSLY CIRCULATING
 - COOLS & WARMS LEAF SURFACE PROVIDING UNIFORM TEMP.
 - REMOVES WARM MOIST AIR & REPLACES W/ DRIER AIR (DECREASE DISEASE)
 - DECREASE THE INSIDE TEMP DURING SUNNY DAYS
 - SUPPLIES CARBON DIOXIDE TO PLANTS

Types of Ventilation

- Need:
 - **Ridge Vents**: remove hot air at highest pt of greenhouse
 - **Side Vents**: side of the house to provide desirable air currents
- Hand Operated Roof Vents
- Automatic Ventilation System
 - Control by thermostat
 - Exhaust Fans: need to be large enough to have complete air exchange in 60 seconds

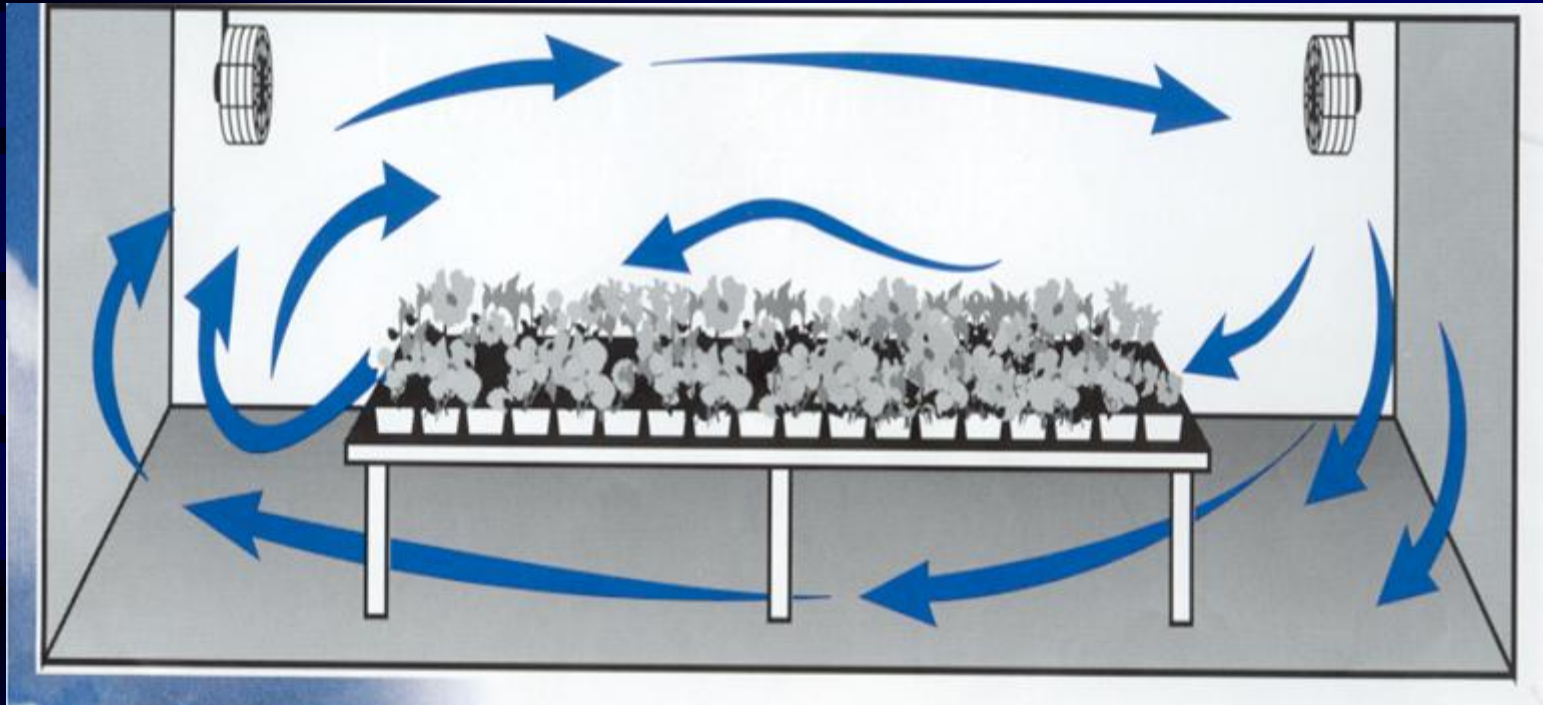
Ridge Vents



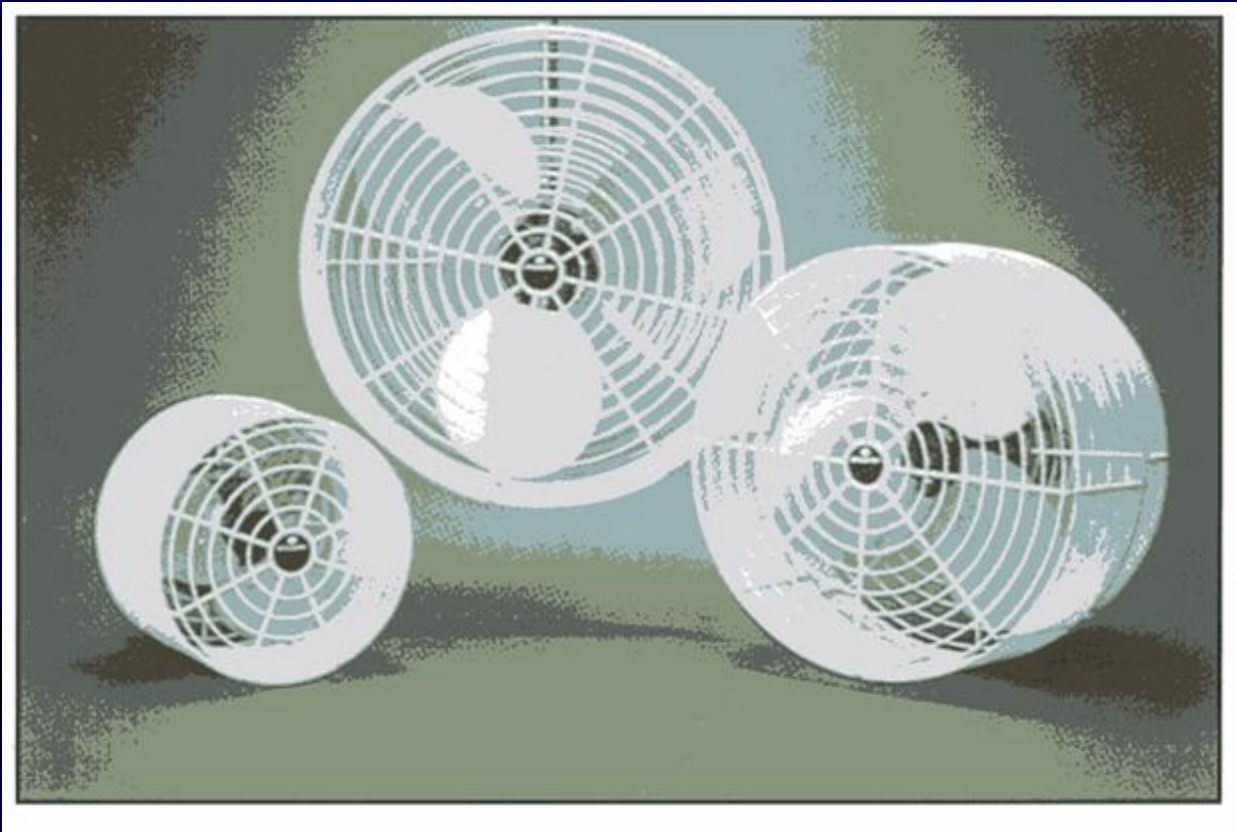


Ventilation Equipment

- Ridge Vent
- Exhaust Fan (1, 2 speed for small houses)
- Vents in back of Greenhouse
- Air Circulation: Poly Tube or Air Flow Fans
- **Horizontal Air Flow Fans:**
 - Fans should operate continuously to push air horizontally on one side of house & in opposite direction on other side of house
 - Position Fans at least 12” from the Roof



Horizontal Air Flow Fans



Cooling the Greenhouse

- Ventilation & Circulation System
- Roll up screens of wood
 - Lath available w/pulleys: decrease radiation 50%
- Shade Cloth
 - uniform shade, exact degree of shade, light wt. & easy to install
- Paint - On Shades: glass & polycarbonate
 - mix w/ water and spray on
 - remove w/ hot water & soap & brush

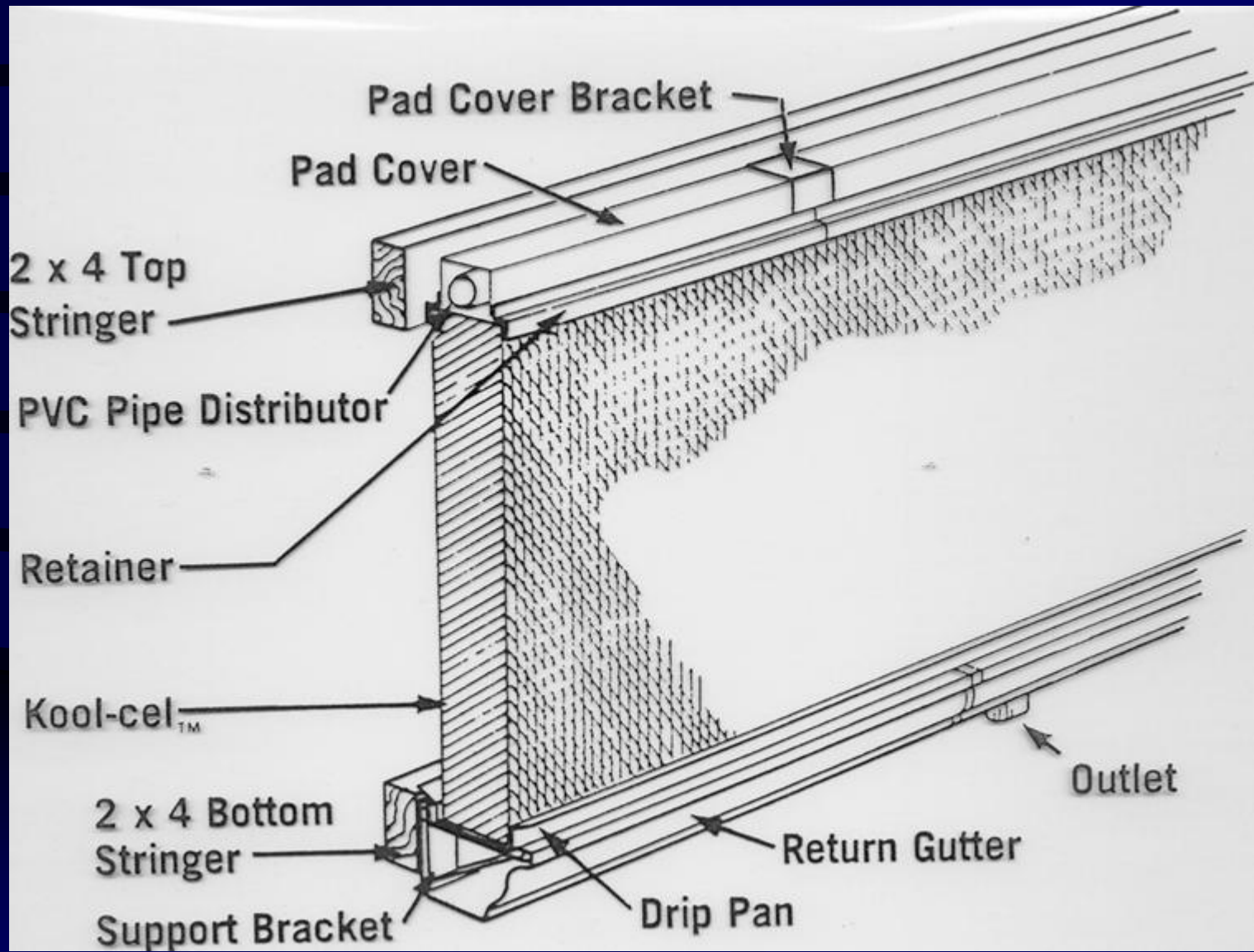
- **Vinyl-Plastic Shading:**

- Rolls 55-65% shade apply by washing area & smoothing plastic on area

- **Fan & Pad: Evaporative Cooling**

- Moves air through a wet pad and it takes 1000 BTUs of heat to change 1lb of water to vapor = reduction of air temperature
- Cooling capacity depends on the outside humidity
- Equipment Needed:

- **PADS** **PUMP** **PVC PIPE**
- **WATER TANK** (1 GAL/ FT LENGTH OF PAD)
- **VENT**



- **MIST COOLING**

- SPRAY TINY WATER DROPLETS INTO AIR
- REQUIRES MANY MIST HEADS OPERATED AT HIGH PRESSURE

- **PROBLEMS:**

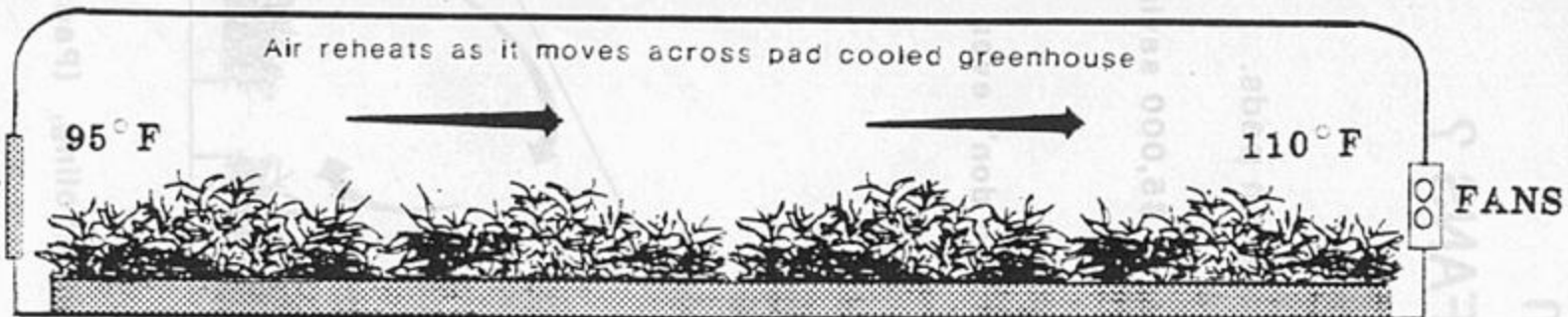
- IF MIST CARRIES ANY MINERALS DEPOSITS CAN BE LEFT & DAMAGE FOLIAGE, WET FOLIAGE INCREASE DISEASE PROBLEMS

PAD COOLED GREENHOUSE

OUTSIDE

115° F
10%RH

PADS

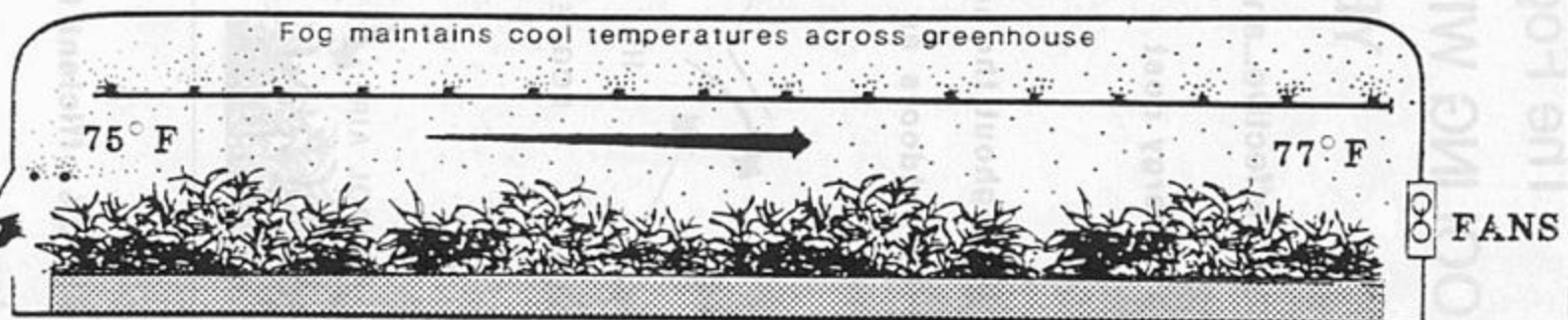


FOG COOLED GREENHOUSE

OUTSIDE

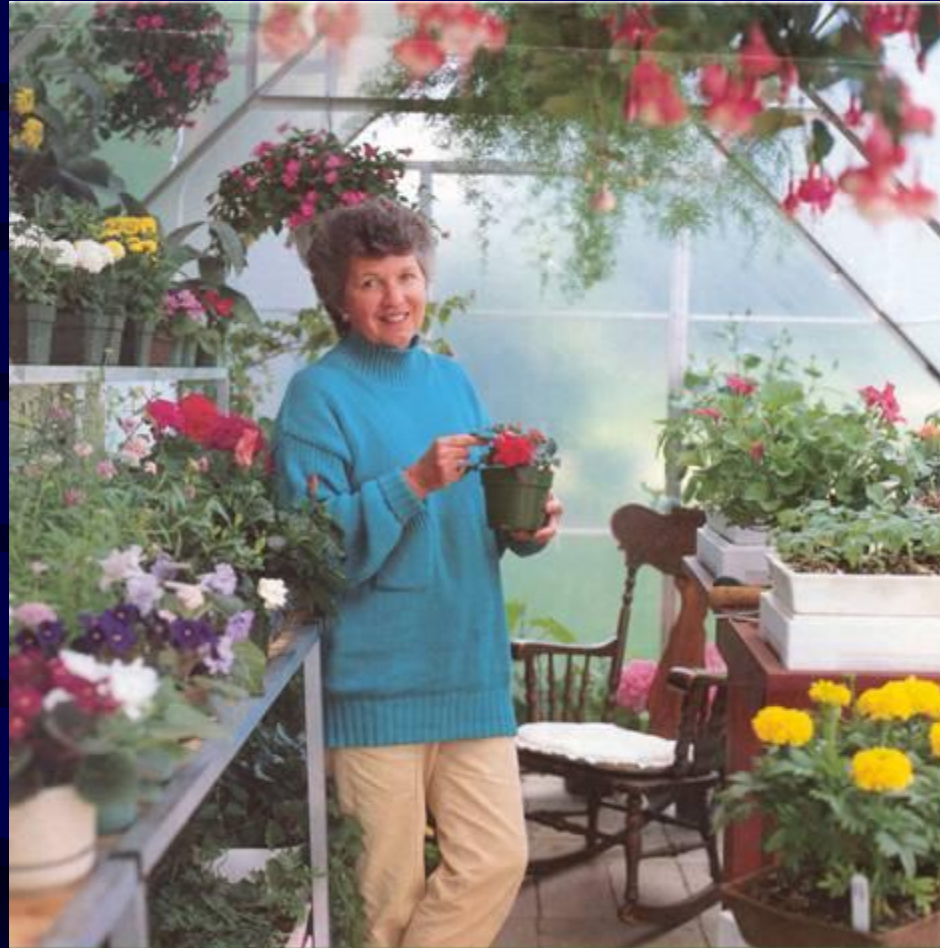
115° F
10%RH

FOG



FOG COOLING VS. PAD COOLING

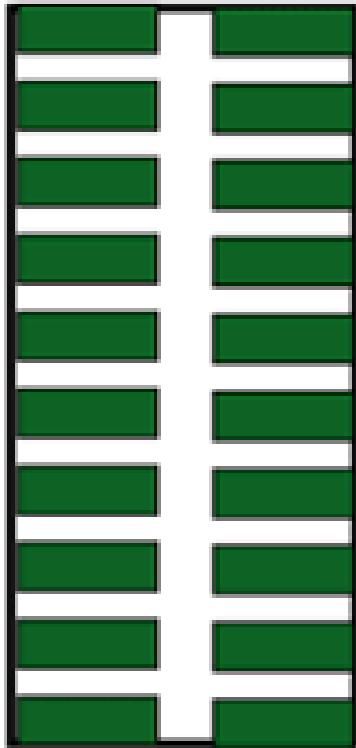
ARIZONA (Low Humidity Day)



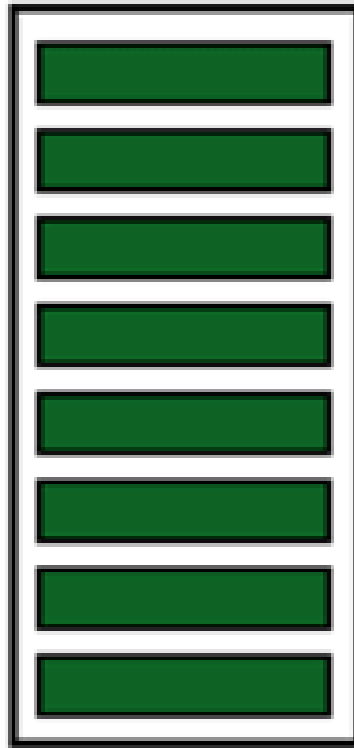
TIME TO GROW SOME PLANTS !!!

Different types of benches and bench arrangements

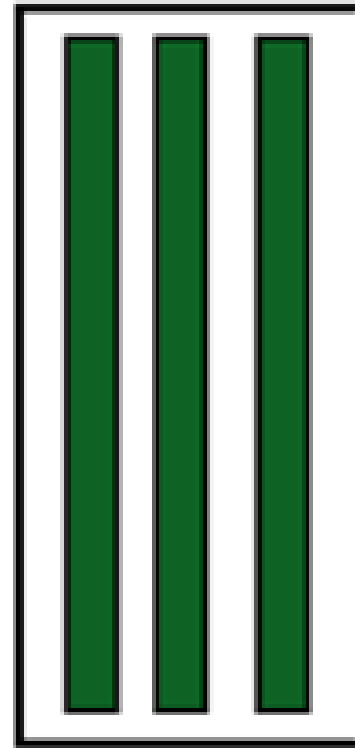
- 3 types of bench arrangements



Peninsular
Easy access with
maximum growing area



Cross benching
Easy access but
less growing area



Longitudinal
Easy mechanization
but difficult access

- Types of benches

- Prefabricated plastic- lightweight, strong vinyl material



Welded wire- 14-gauge galvanized wire coated with a plastic



Wood bench fabrics- lath or snow fencing



Redwood Bench

Moveable benches- 14-gauge galvanized expanded wire on frames with steel rollers

