
Gardening in the Greenhouse


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Cultivation of crops is mainly climate dependent in normal conditions. All fruits and vegetables have their own seasons in which they can be grown. But with the **greenhouse** technology, farmers can grow almost any fruits, ornamentals and vegetables in any season. This technology has made possible to have all vegetables throughout the year.

Green house technology provides a controlled and favorable environment for the crops to grow in all seasons. The technology saves crops from cold in winter, from heat in summer and from rain in monsoon. Unlike European countries, in tropical area the technology is primarily used in cooling off the environment, as normal temperature is high.

Greenhouse cultivation as well as other modes of controlled environment cultivation have been evolved to create favorable micro-climates, which favors the crop production could be possible all through the year or part of the year as required.

Greenhouse technology is more suited to vegetables crops (such as tomato, cauliflower, capsicum, cabbage, chillies, spinach etc.), flowers (like rose, gerbera, carnation etc.) and nursery for all vegetable crops, because of their small life-span. This technology is mainly suitable for commercial farming, as it requires investment in setting up the entire framework.

It involves a structure similar to a house, in which only sunlight is allowed to enter. It has mainly two parts, first is a frame or the basic structure made of galvanized iron pipes, aluminum pipes, bamboo, woods and iron rods, and the second is the cladding or covering material made of glass and plastic films etc.

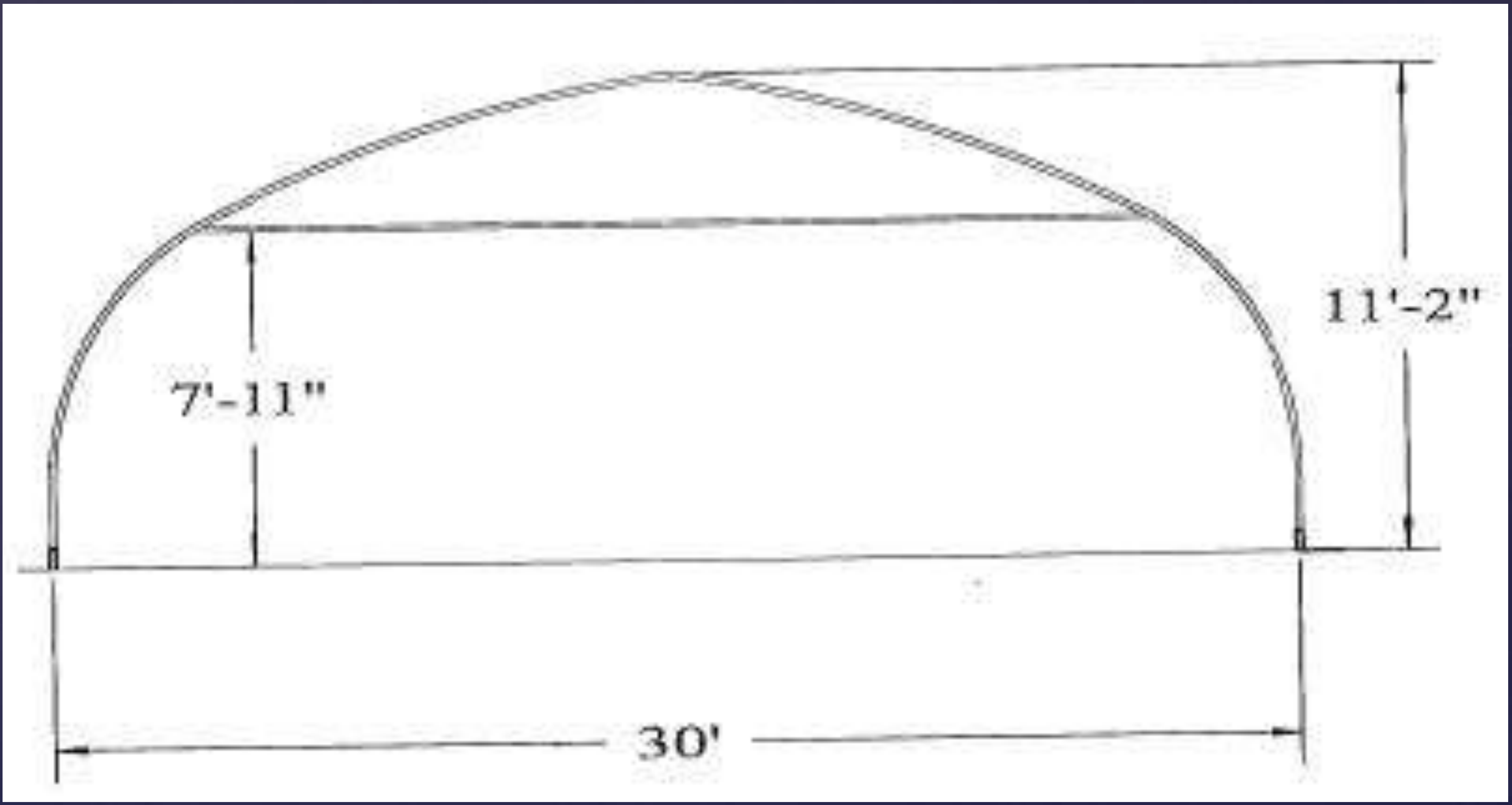
Greenhouses are covered with a transparent material in which crops are grown under controlled environment conditions.
The primary environmental parameter traditionally controlled is temperature, usually providing heat to overcome extreme cold conditions. However, environmental control can also include cooling to mitigate excessive temperatures, light control either shading or adding supplemental light, carbon dioxide levels, relative humidity, water, plant nutrients and pest control.

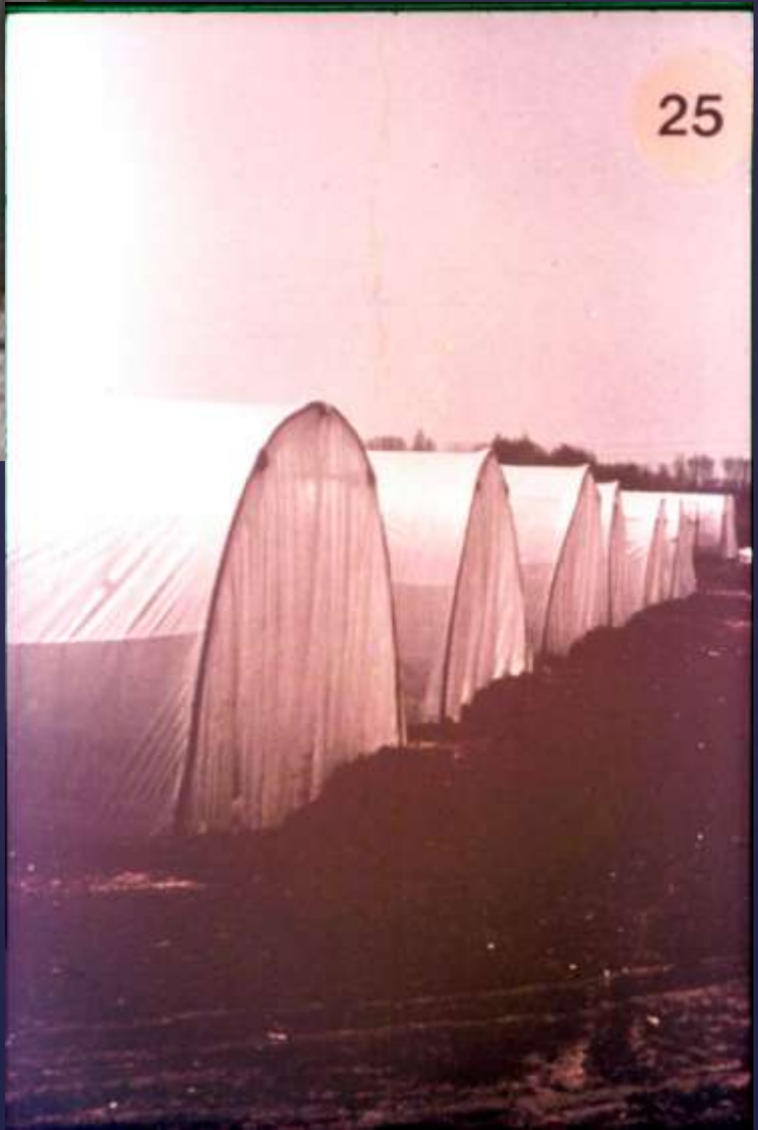
Classification of greenhouses possible by

- Structure
- Covering material
- Height: cold frame → high tunnels
- Building costs
- Heating rate etc.

Classification by the type of structure

a. Quonset and curved roof type
b. Gable roof type


11'-2"
7'-11"
30'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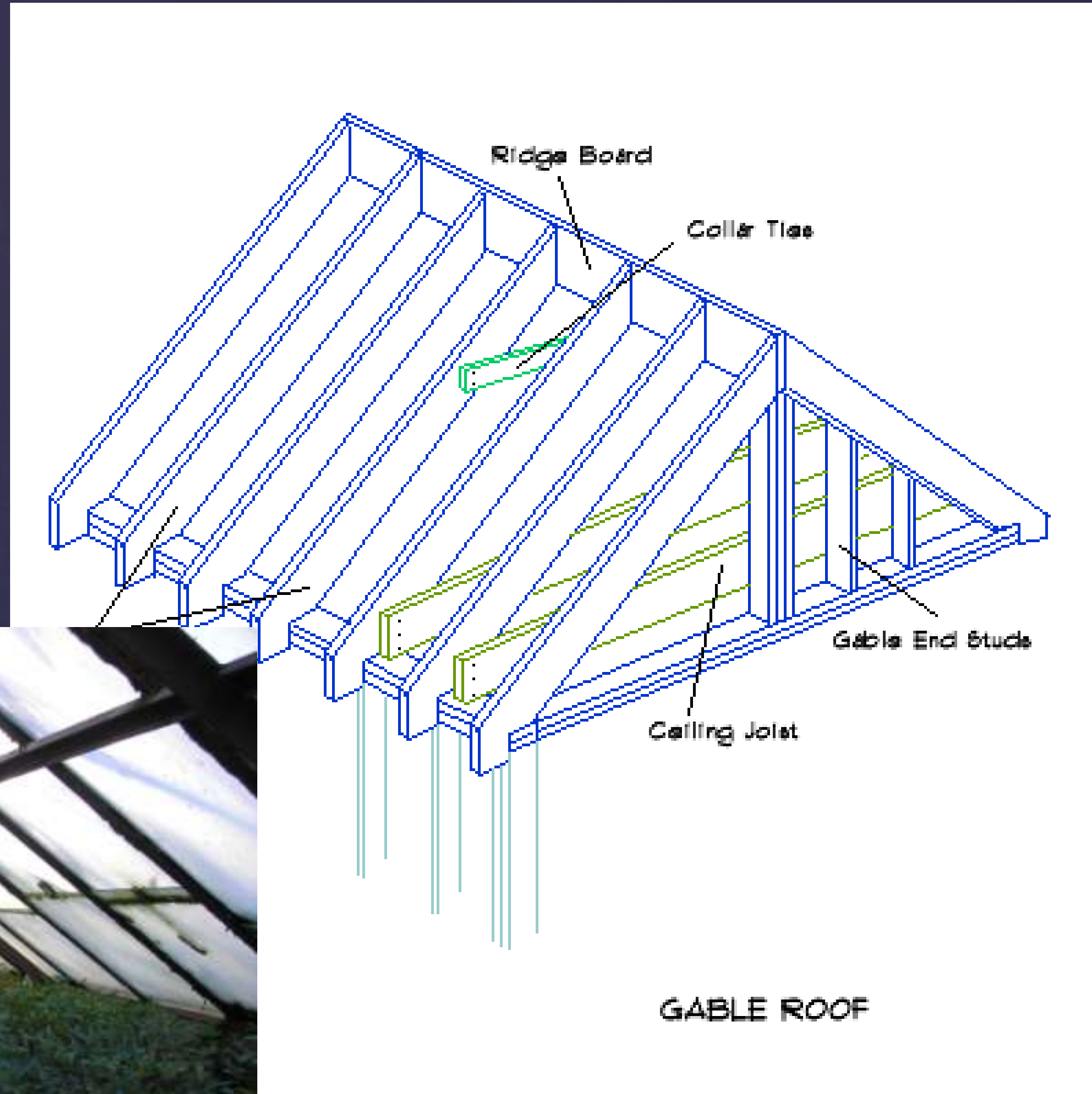

Ridge Board
Collar Ties
Gable End Studs
Ceiling Joist
GABLE ROOF

Glazing

Classification as per glazing

a. Glass glazing
b. Fiberglass reinforced plastic glazing
    i. Plain sheet
    ii. Corrugated sheet
c. Plastic film
    i. Ultra violet stabilized low density poly- ethylene

GLAZING CLASSIFICATIONS by National Greenhouse Manufacturers Association, (NGMA), USA.

Various glazing materials have radically different response to environmental conditions such as solar irradiance, wind, snow, and hail (jégeső); and are by virtue of composition and manufacturing parameters quite different in physical properties, NGMA has elected to describe three different categories of glazing:

Type I

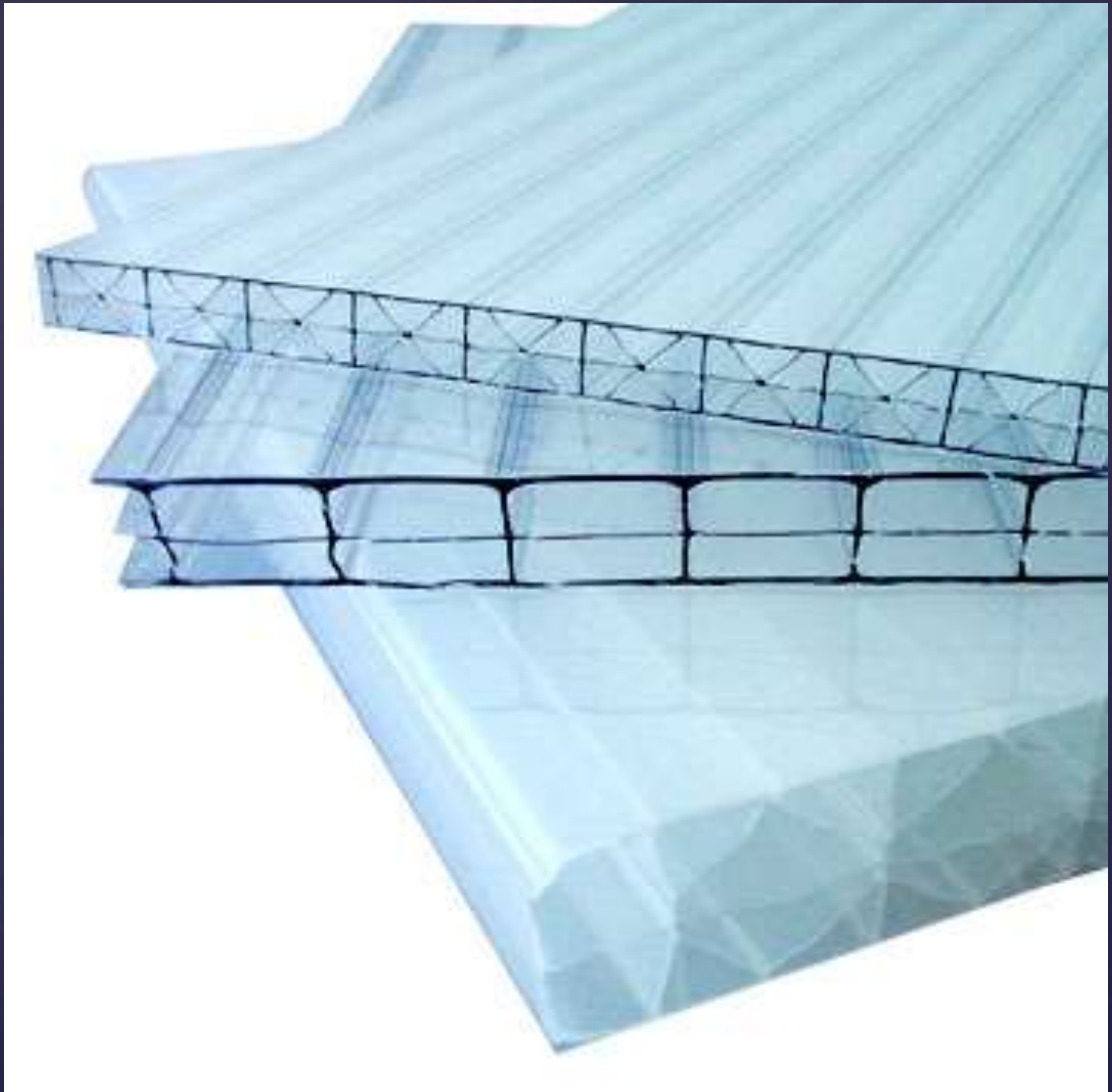
Thin films, generally ranging from 2-8 mills (.002"-.008") normally double layer, air inflated

Polyethylene,
EVA (ethylene vinyl acetate),
polyvinyl chloride (PVC),
polyvinyl fluoride and
polyester films fall into this category.

Type II

"Flexible plastics such as fiberglass reinforced plastic (Thermoset Polyester (FRP), acrylic, polycarbonate, polypropylene, PVC, and PETG panels and the "ladder profile"("Multiwall") type structured materials such as polycarbonate, acrylics, Polypropylene, PETG and laminar composites of both (any)."

This includes the following:



Flexible Thermoplastics

o Multiwall Acrylic Sheet
o Monolithic Acrylic Sheet
o Corrugated Acrylic Sheet
o Double & Multiwall Polycarbonate Sheet
o Monolithic Polycarbonate Sheet
o Corrugated Multiwall Polycarbonate Sheet
o Corrugated Monolithic Polycarbonate Sheet
o Monolithic PETG Co-Polymer (Glycol modified Polyester Terephthalate)
o Multiwall Polypropylene Sheet
o Monolithic PVC Sheet

Flexible Thermoset Polyester Plastic Sheet (Glass Reinforced FRP)

o Monolithic fiberglass sheet
o Corrugated fiberglass sheet

Composites

o Combinations of Glazing plastics laminated to each other
o Combinations of Glazing plastics laminated to Glass

TYPE III

Rigid Materials - Glass:

Float Glass, annealed, chemically strengthened, tempered and laminated forms of float, annealed, chemically strengthened, tempered, and rolled patterned glass.

Size

The cloche (pronounced klosh) was originally a bell-shaped glass jar set over delicate plants to protect them from the elements

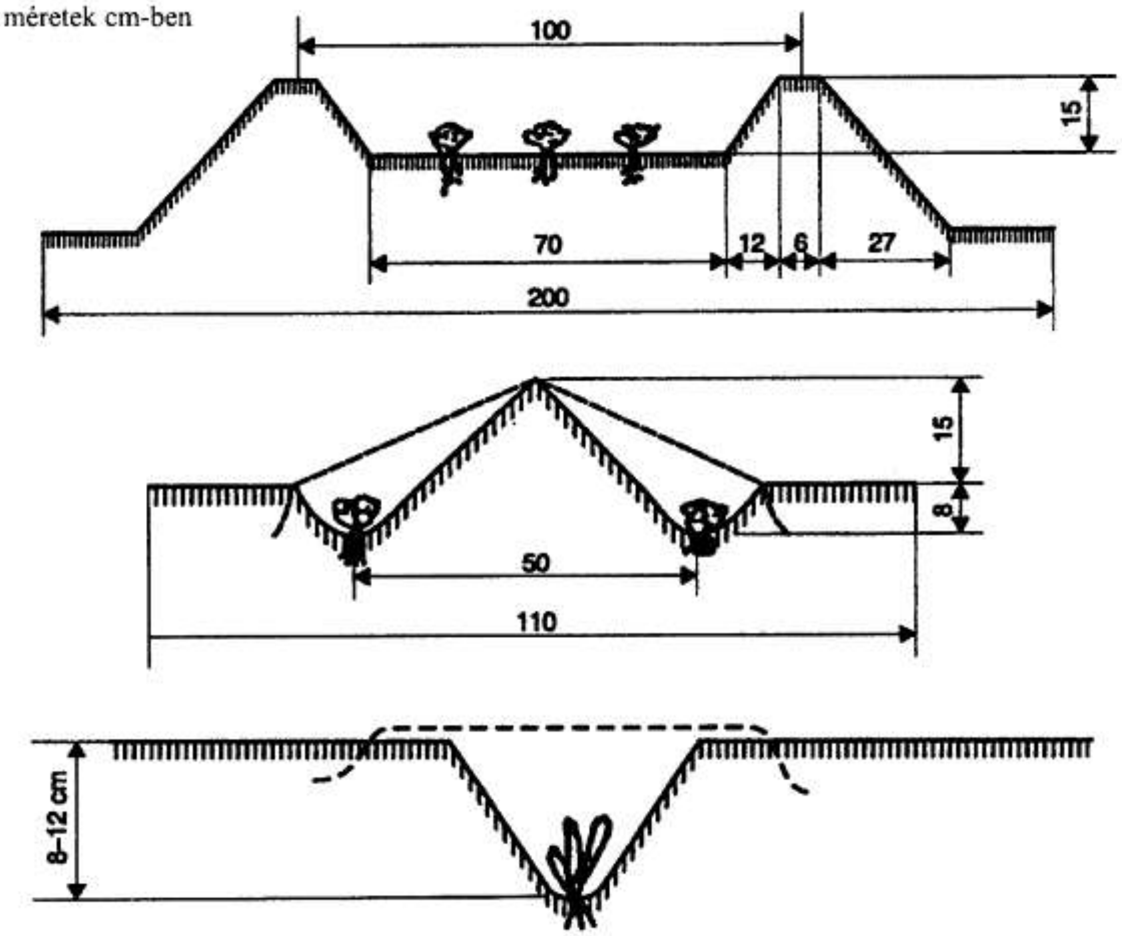
Floating Row Covers

Row covers are a more recent development in extending vegetable production past frost dates. They are simple devices, pieces of material (in spunbonded polyesters) laid over transplants in the field. As the plants grow taller, the plants push up the material. Row covers retain heat and protect against frost so crops can be planted earlier in the spring and harvested later in the fall.

They have also protecting plants from wind damage. Row covers generally provide 4 to 5 degrees of frost protection, so cool-season crops can be planted in air temperatures as low as 28°F (-2°C) . Covers should be removed from the crops when air temperatures beneath the cover reach 80°F (27°C).

187. ábra
Fóliaalagút kettős fóliatakarással

195. ábra
A fóliát időben meg kell nyitni a megporzást végző rovarok előtt *(Fotó: Nagy József)*

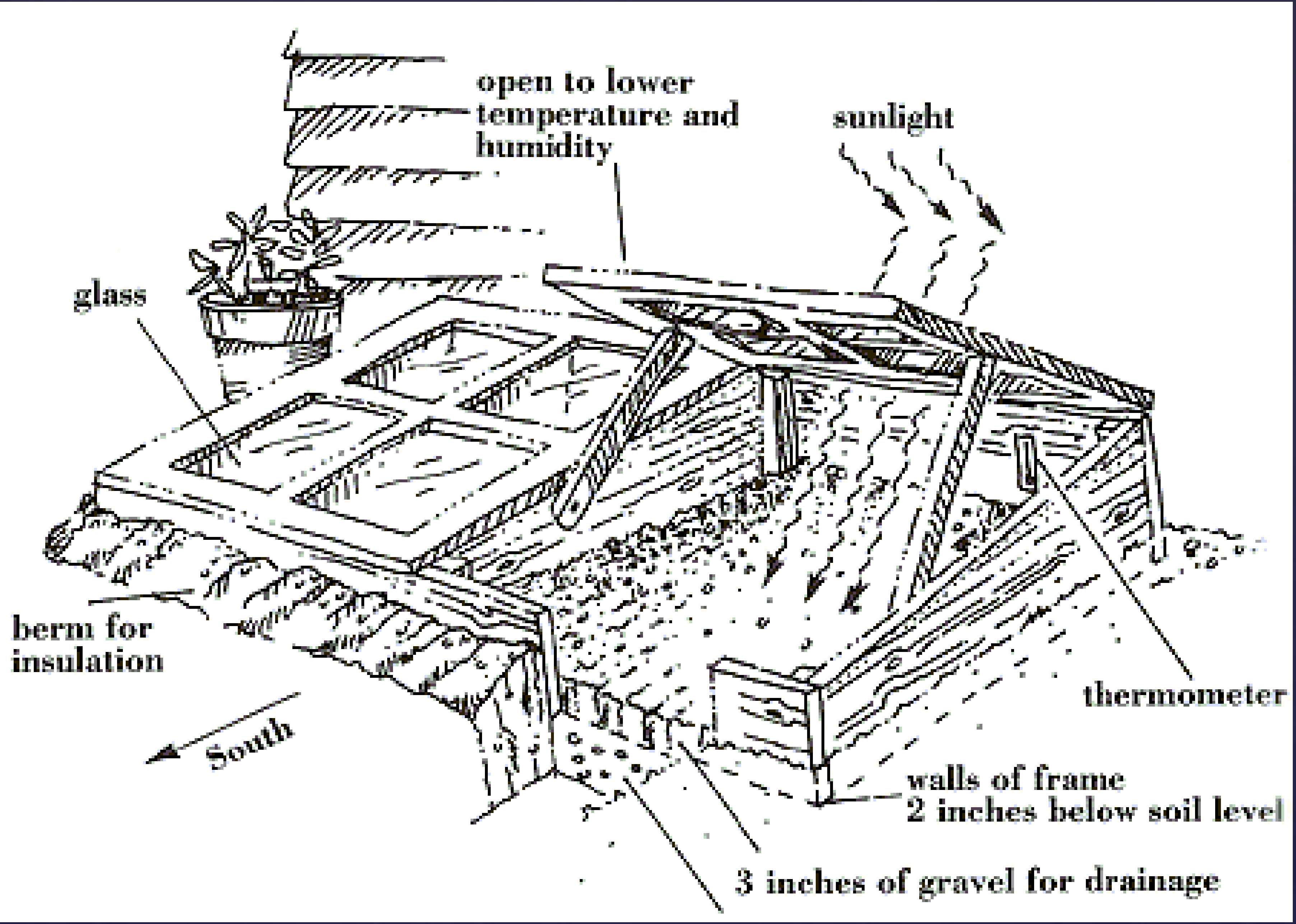


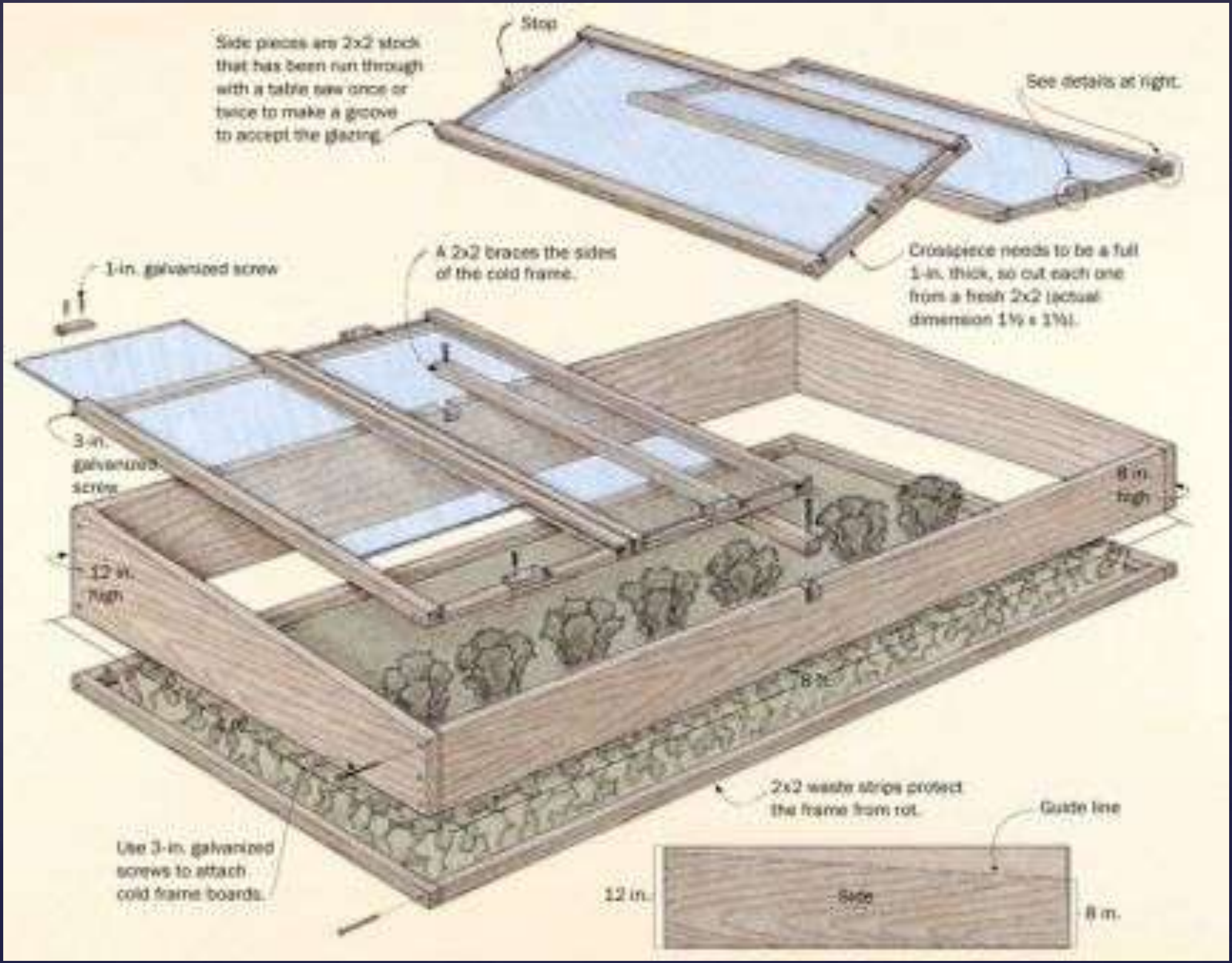
5. ábra. A váz nélküli fóliatakarás lehetséges megoldásai

Cold frames, sun boxes, and hot beds are relatively inexpensive, simple structures providing a favorable environment for growing cool-weather crops in the very early spring, the fall, and even into the winter months. Cold frames and sun boxes have no outside energy requirements, relying on the sun for their source of heat. Hot beds are heated by soil-heating cables; steam-carrying pipes; or fresh, *strawy* manure buried beneath the rooting zones of the plants. All of these different types of structures collect heat when the sun's rays penetrate the sash (window), made of clear plastic, glass, or fiberglass.

COLD FRAMES

A cold frame is an outdoor growing "area" built without a bottom but with a solid-sided frame of wood, cement or brick, and a removable hinged top, glazed with glass, Fiberglas, or plastic. The ideal location for a cold frame is a southern or southeastern exposure with a slight slope(lejtő) to ensure good drainage and maximum solar absorption.


open to lower
temperature and
humidity
sunlight
glass
berm for
insulation
thermometer
South
walls of frame
2 inches below soil level
3 inches of gravel for drainage


Stop
Side pieces are 2x2 stock that has been run through with a table saw once or twice to make a groove to accept the glazing.
See details at right.
Crosspiece needs to be a full 1-in. thick, so cut each one from a fresh 2x2 (actual dimension 1½ x 1½).
A 2x2 braces the sides of the cold frame.
1-in. galvanized screw
3-in. galvanized screw
12 in. high
8 in. high
8 in.
2x2 waste strips protect the frame from rot.
Guide line
Use 3-in. galvanized screws to attach cold frame boards.
12 in.
Side
8 in.


23

22

24

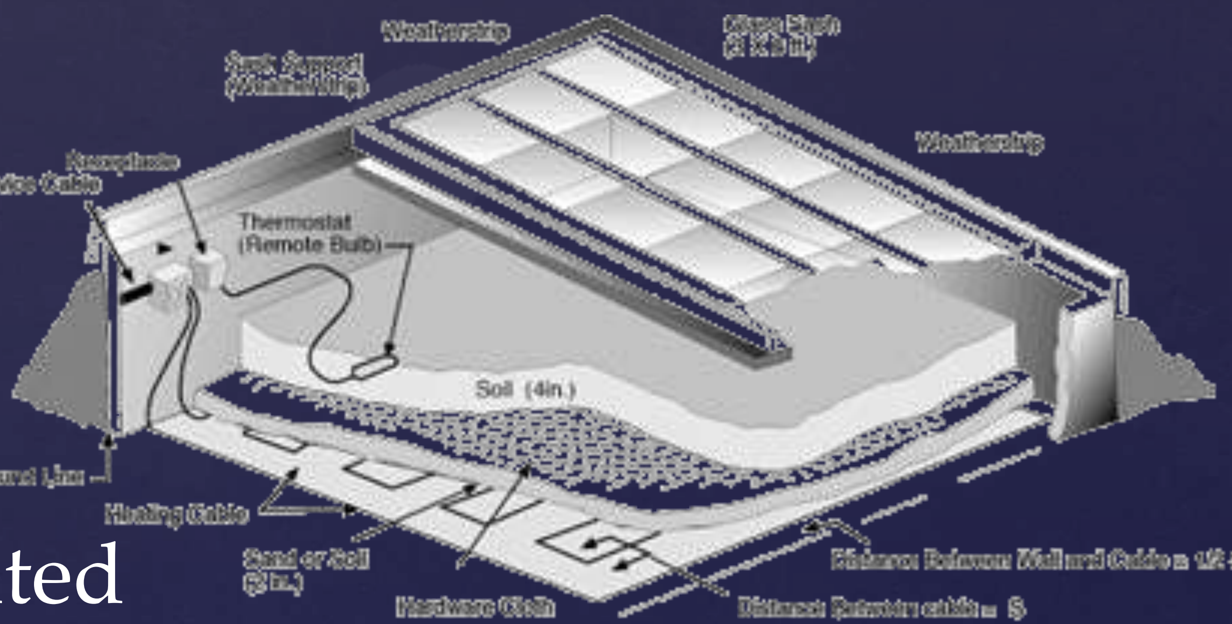

THE HOTBED

A hotbed, obvious as it may sound, is basically a cold frame with heat. While cold frames receive all of their heat directly from the sun, hotbeds are heated with electric soil cables, stable manure or steam, or hot water heated with flues. The hotbed can be used earlier in the spring and later in fall and early winter than the cold frame.

Hotbeds are constructed just the same as cold frames, with a slope to the south to admit heat from the sun and to allow water or snow to run off. Plants growing in these frames are protected on cold spring nights with the same kind of mats suggested for cold frames.

Hotbeds are usually built to be permanent structures, with the frame of wood, concrete, or brick extending into the ground below the frost line.

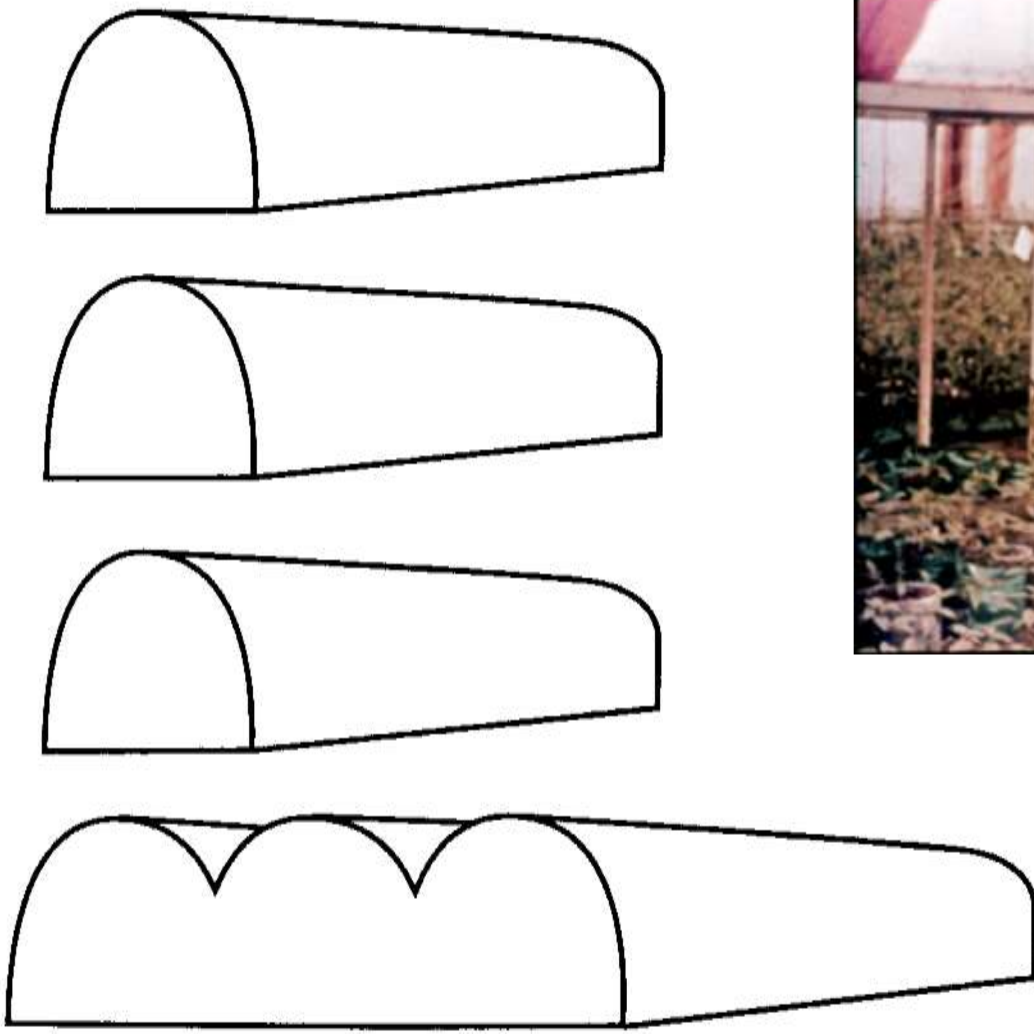
Stable manure
„heated" hotbed



Construction of an electrically heated hotbed

Electrically heated
hotbed

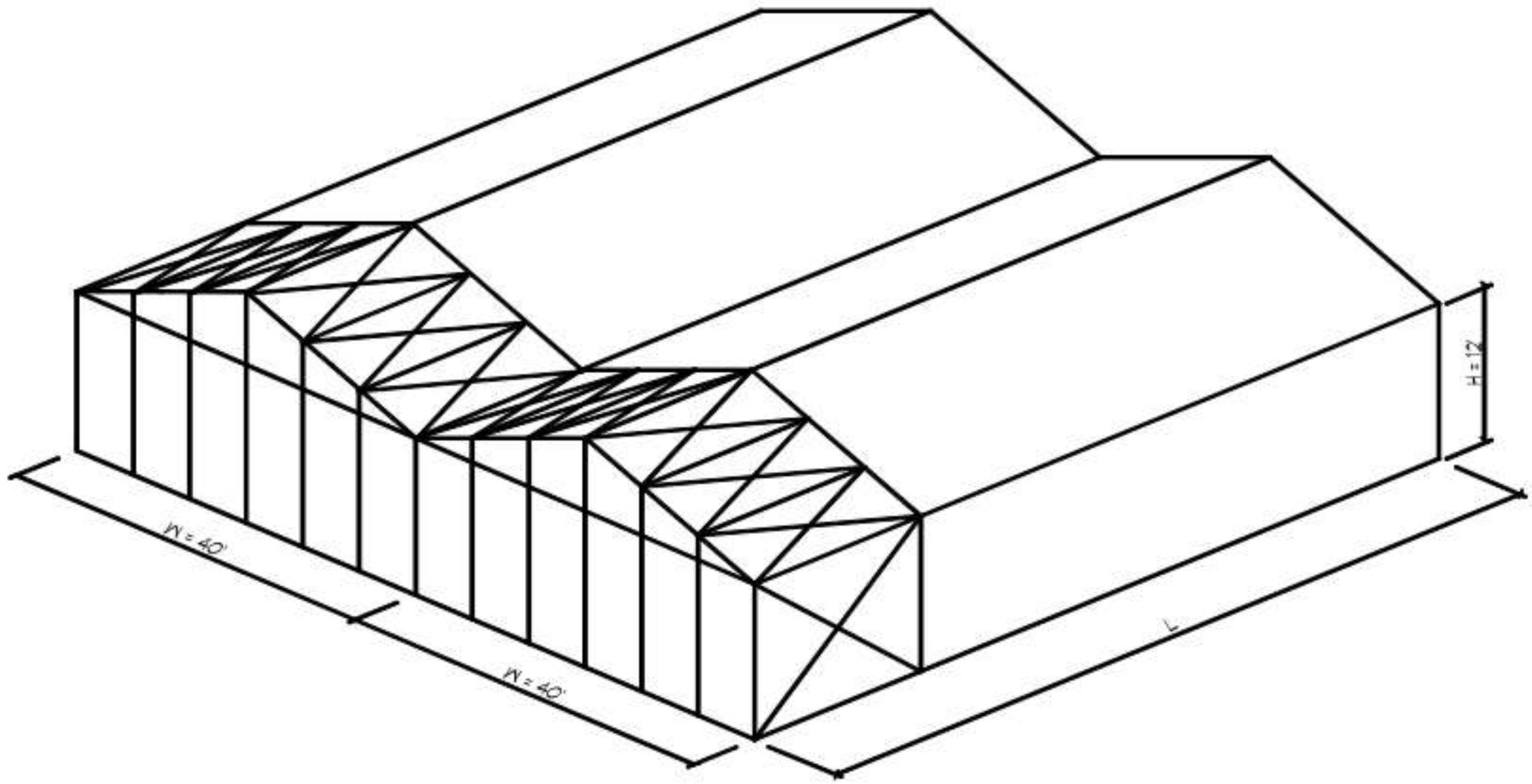
High tunnels and glasshouses



[redacted] These three freestanding greenhouses have the same growing area as the gutter-connected house, but a much greater exposed surface area.

Gutter-conected plastic tunnel

Gutter connected production greenhouse
40 ft span, symmetrical



Classification by building costs

Low-cost Green House :

It is made of polythene sheet. Its size depends on the purpose of its utilization and availability of space. It has one opening which is kept open for 1-2 hour during the day, especially in the morning to reduce the level of humidity inside. The temperature within polyhouse increases by 6-10 °C more than outside. In Ultra Violet (UV) stabilized plastic film covered, pipe framed polyhouse, the day temperature is higher than the outside. The solar radiations entering the polyhouse is 30-40% lower than that reaching the soil surface outside.

Medium-cost Green House :

With a slightly higher cost, an arc-shaped polyhouse (green house) can be framed with GI (galvanised iron) pipe of 15 mm bore. This polyhouse has a single layer covering Ultra Violet – stabilized polythene. It has heating system, thermostatically controlled exhaust fans are used for ventilation. Cooling pad is used for humidifying the air entering the polyhouse. The polyhouse frame and glazing material have a life span of about 20 years and 2 years respectively.

Hi-tech Green House :

In such type of green houses, temperature, humidity and light are automatically controlled. These are indicated through sensors or signal receivers. Sensor measures the variables, compare the measurement to a standard value and finally recommends to run the corresponding device. For example, temperature control system consists of temperature sensor, heating/cooling mechanism and thermostat-operated fan.

Similarily, relative humidity is sensed through optical tagging devices. Boiler operation, irrigation and misting systems are operated under pressure sensing system. This modern structure is highly expensive and requires qualified operators for maintenance, care and precautions.

HEATED GREENHOUSE ENVIRONMENTS

Greenhouse heating is an important issue to consider for your hobby or commercial greenhouse. The night temperature in a year-round greenhouse is the most important factor to determine which heating system is required. The greenhouse gardener also determines whether to winter over plants or to provide a constant growing environment.

Cool or frost free greenhouses maintain a night temperature of 40-45ºF (5-7ºC). This is suitable for frost sensitive plants and rooted cuttings.

Warm greenhouse requires a night temperature of 55ºF (13ºC). Growlights are necessary for adequate light conditions in this environment.

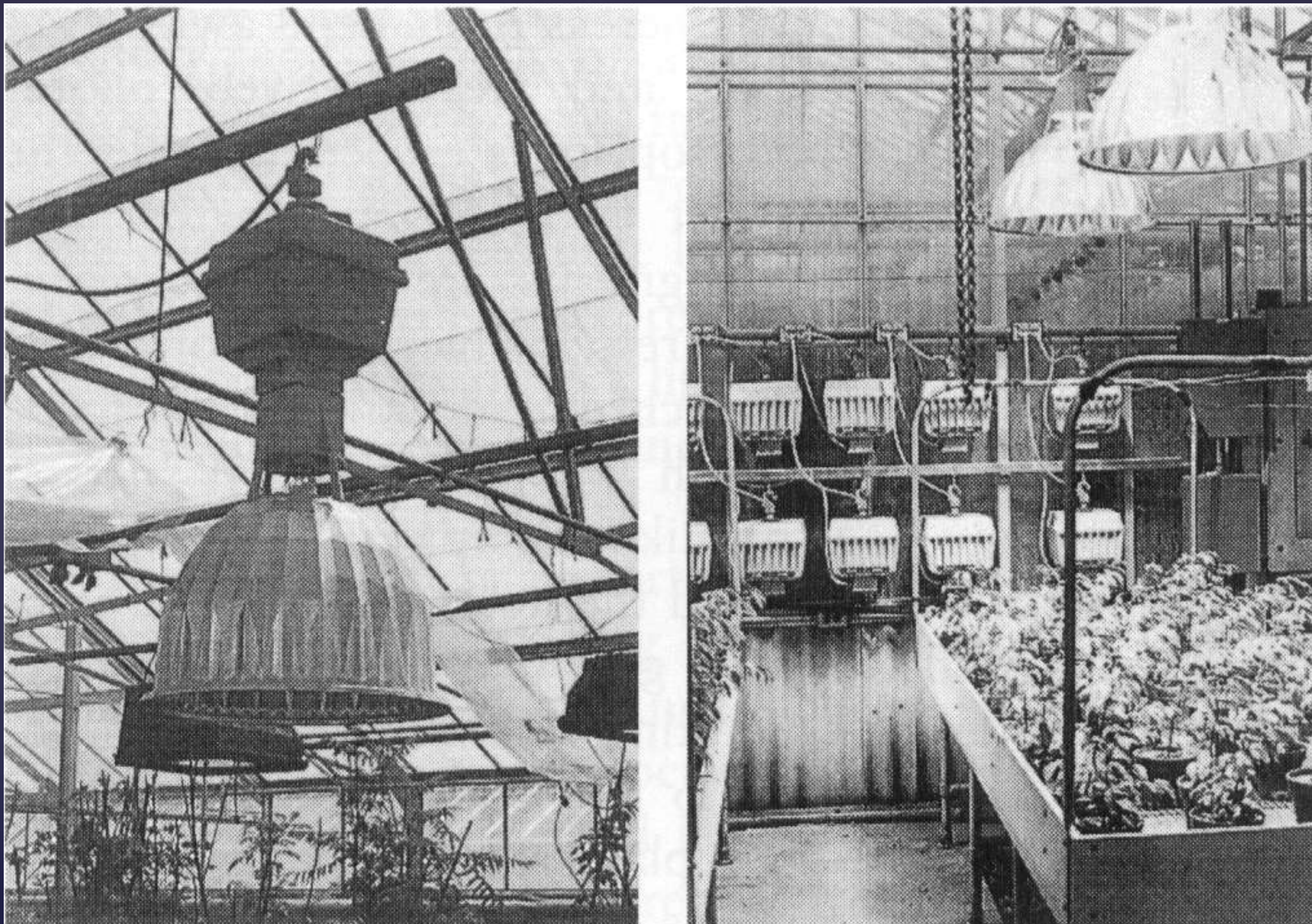
Hothouse night temperatures are set at 65ºF (18ºC).This will provide a natural habitant for tropicals and exotic plants.

Equipments

- Lighting
- Ventilation and cooling systems
- Shading
  Curtain systems
- Heating
- Irrigation system

High-Intensity Discharge (HID) Lamps

HID lamps can be mercury (Hg) lamps, metal halide (MH) lamps, or sodium lamps. Sodium lamps are either high-pressure sodium (HPS) or low-pressure sodium (LPS) lamps; both have greater efficiency than Hg or MH lamps.
HID lamps are rather large, with big ballasts and reflectors. They are generally available in sizes up to 2000 watts, but 400- and 1000-watt sizes of HPS lamps are used commonly. These lamps tend to be expensive compared to fluorescent or incandescent lamps but their life expectancy ranges from 10,000 hours to 24,000 hours, depending on the lamp.



[redacted] HID lamps in greenhouses. [redacted]

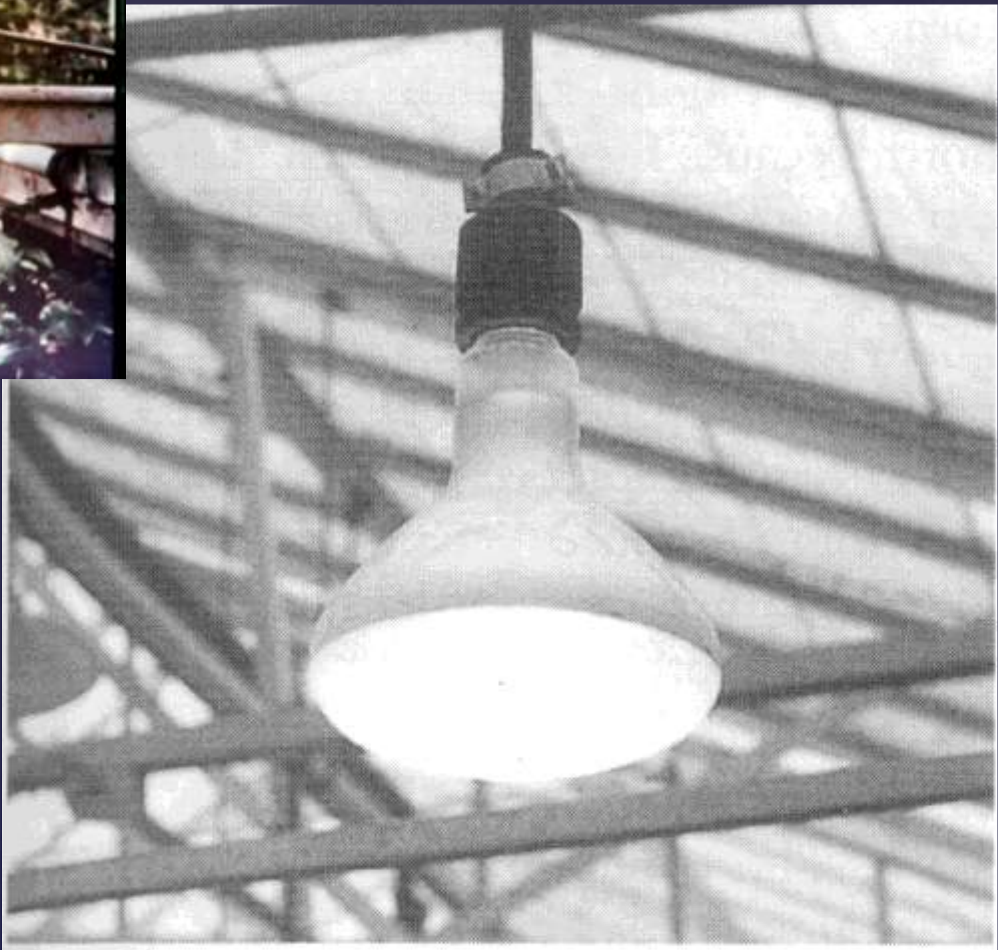
Fluorescent Lamps:

- Cool white (commonly used)
- Warm white

Fluorescent lamps are used more frequently for seed germination and producing plants in tissue culture systems, and hobbysts also favor them.

Incandescent Lamps:

Incandescent lamps are the major light source used for the photoperiodic control of floricultural crops – light at the red-end of the spectrum, emit too much heat.



[redacted] Light bulb with internal reflector used for night interruption on short-day plants, such as chrysanthemums.

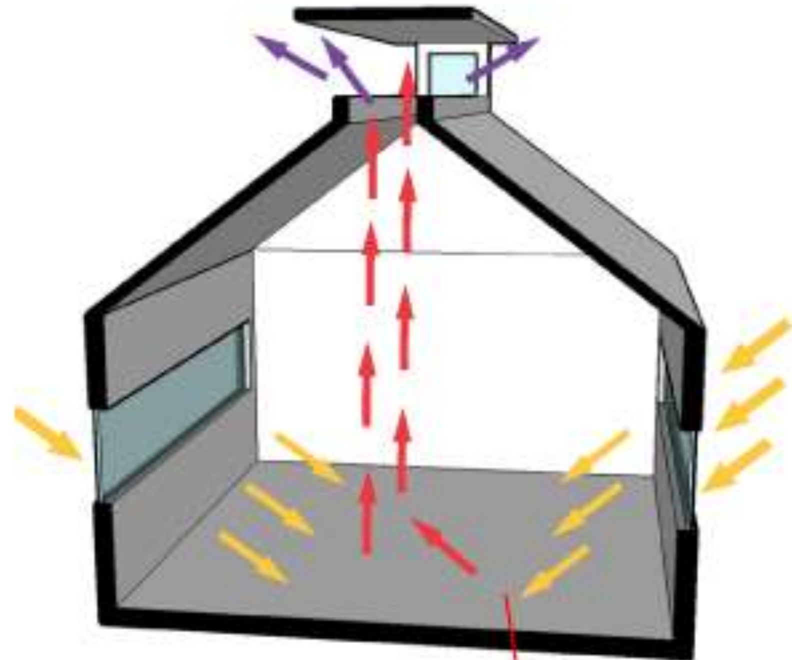
Ventilation and cooling systems

- Vents (stack effect)
- Exhaust fans
- Air conditioning units
- Evaporate cooling system
    - a. fan and pad cooling
    - b. forced mist or fogging units

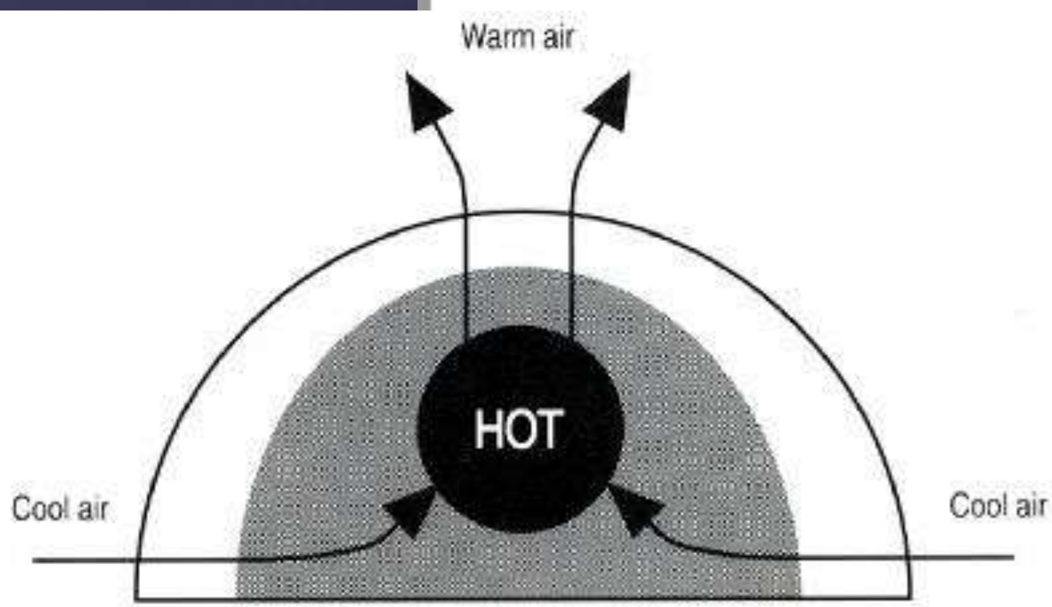
      (These inject a fine mist or fog into the greenhouse that will cool the air.

Roof Monitors and Stack Ventilation

Stack ventilation occurs when warm air in a space rises and exits through openings at the top of the room, which are often in the form of roof monitors at the top of vertical shafts. These are very effective at the top of pitched roofs where warm air collects. Whole house fans are often used at the top of vertical shafts to help air flow out and increase ventilation within a space.



With stack ventilation, warm air is allowed to flow out through the top of the space via openings, often in the form of roof monitors.

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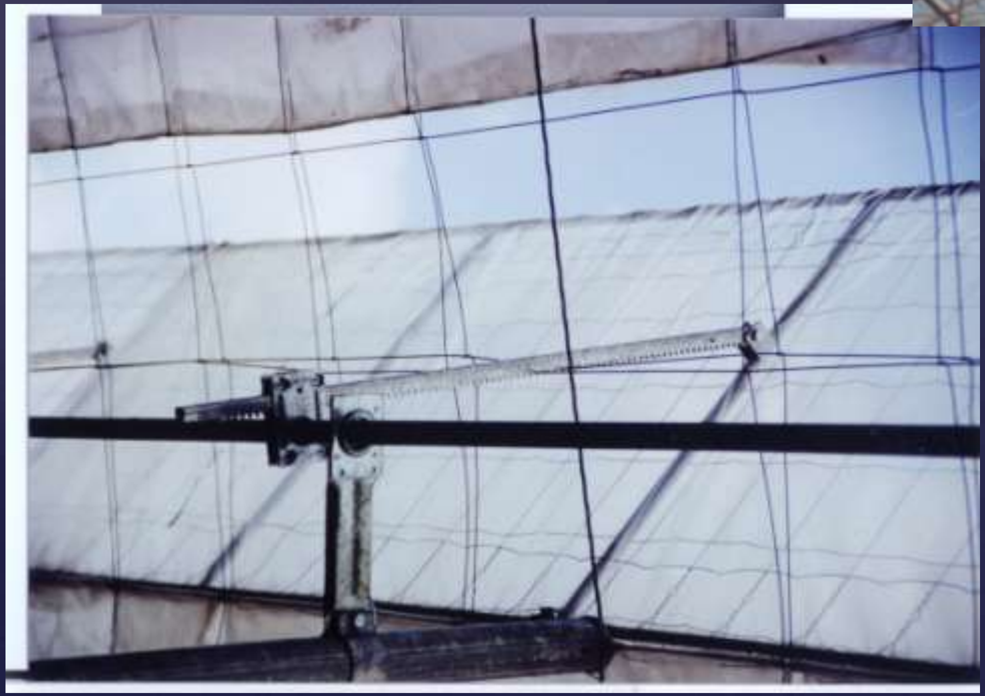
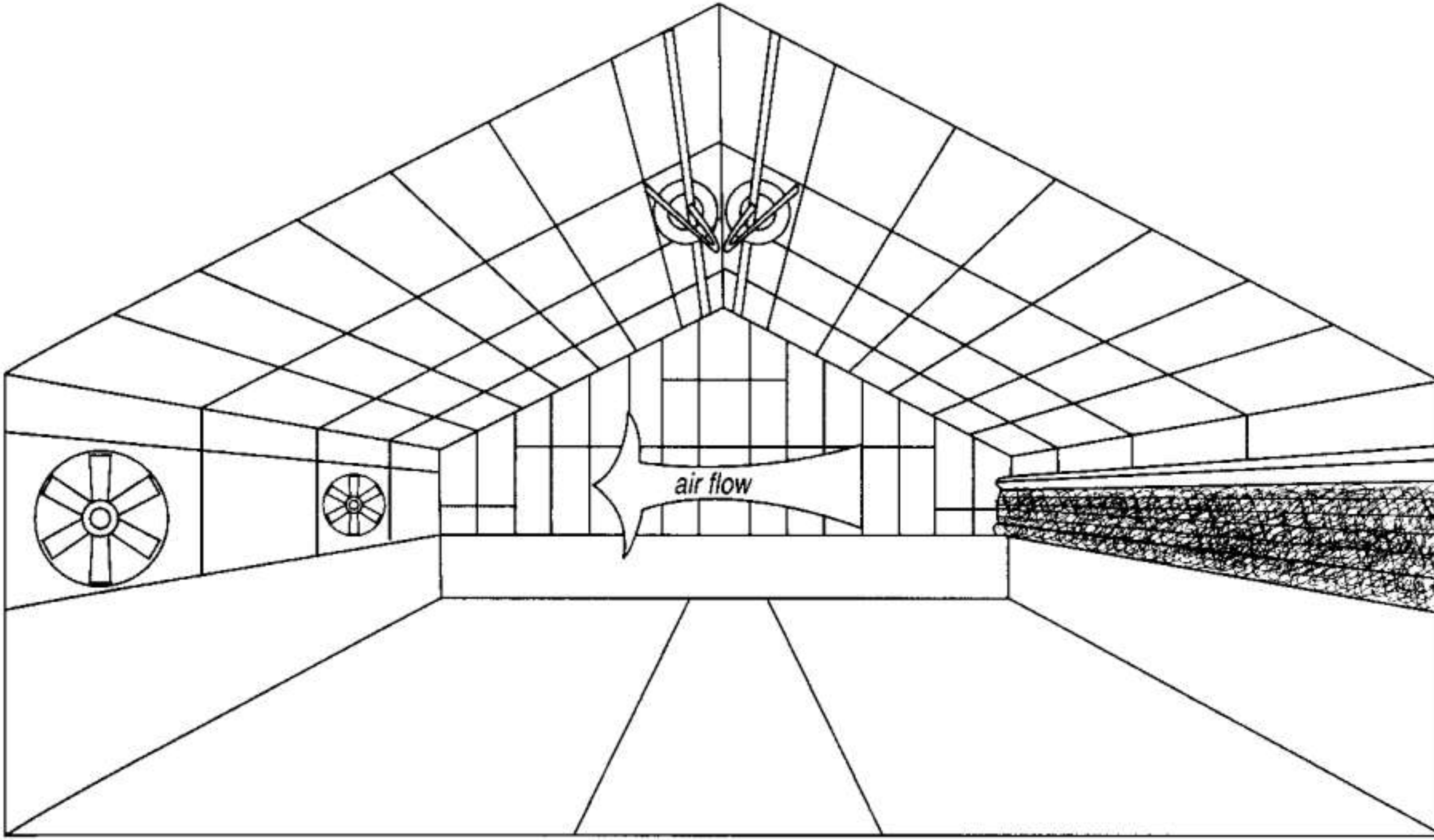
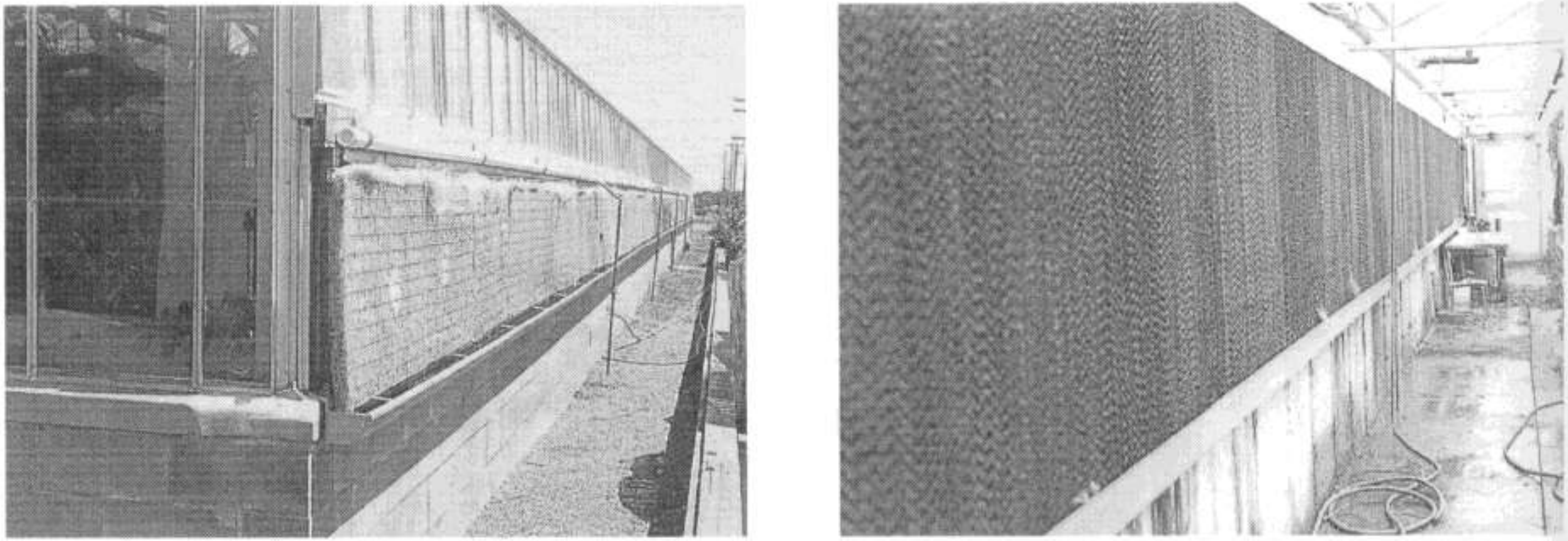


Fan and pad cooling

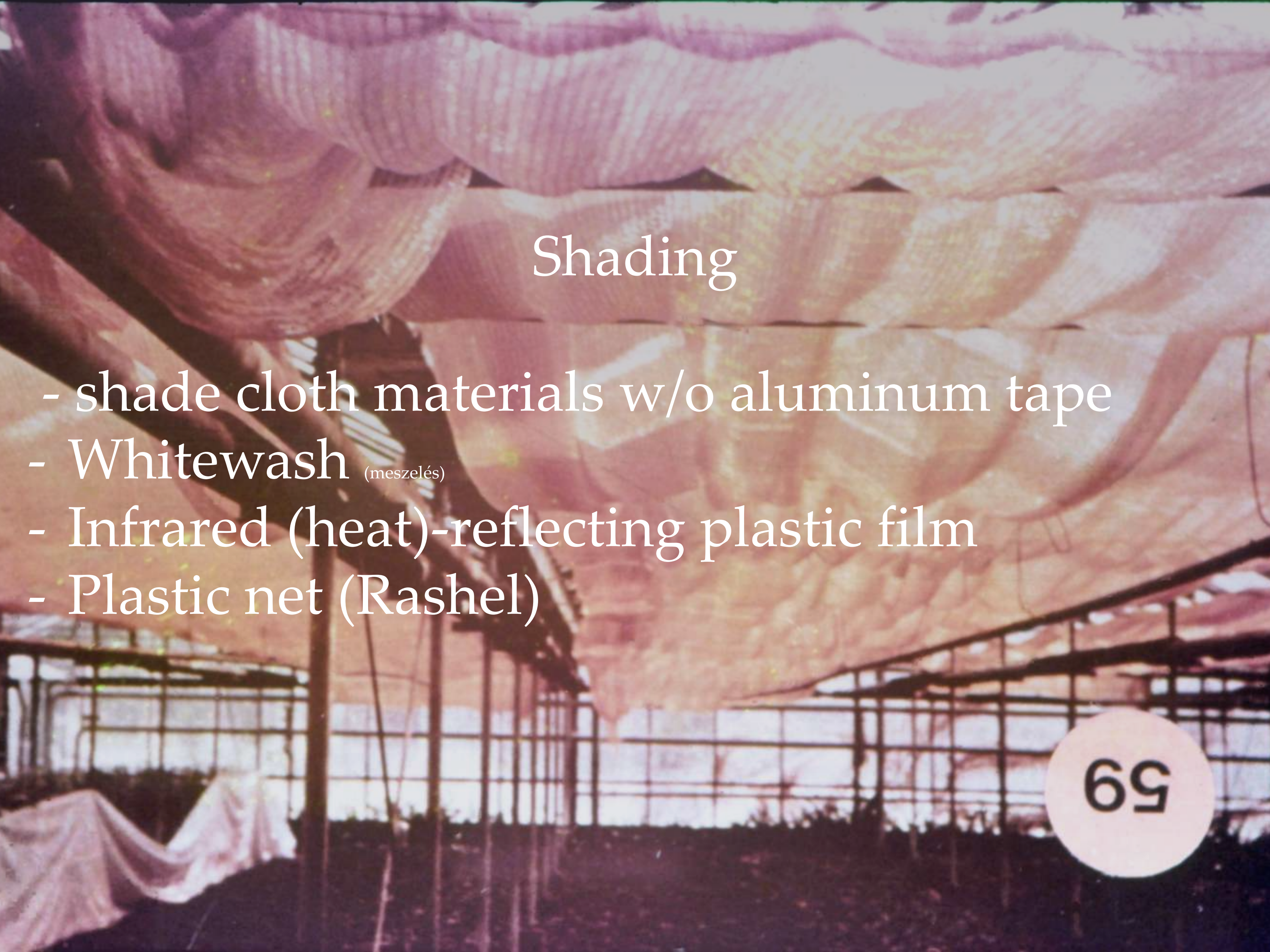
Along one wall in a greenhouse, pads, are located either horizontally or vertically. Water passes through the pads, keeping them wet.
The traditional material for pads are shredded aspen (excelsior), but this material generally has been replaced by across-fluted cellulose material Impregnated with anti-rot salt, wetting agents, and fungicides



[redacted] This drawing of a greenhouse with pads on one wall and fans on the opposite wall illustrates the concept of a fan and pad cooling system.



[redacted] A view of excelsior cooling pads on the outside of a greenhouse (*left*) and cross-fluted cellulose (*right*) from the inside of a greenhouse.



Shading

- shade cloth materials w/o aluminum tape
- Whitewash (meszelés)
- Infrared (heat)-reflecting plastic film
- Plastic net (Rashel)

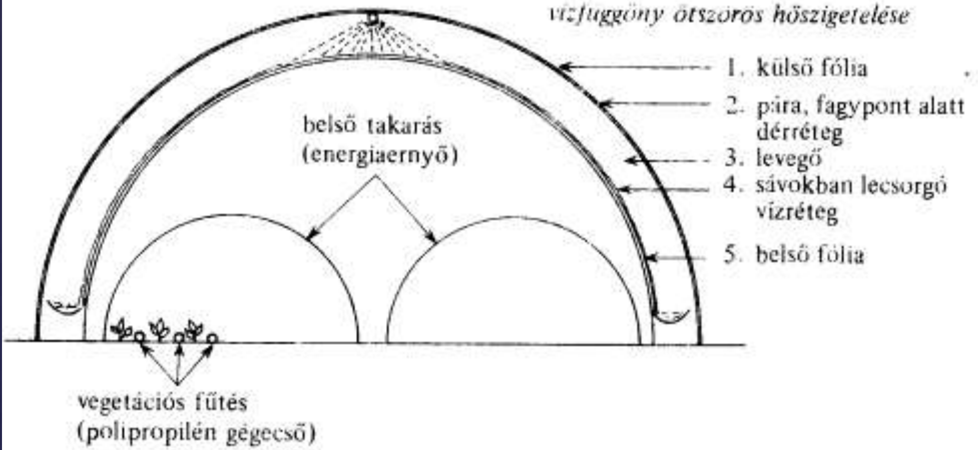
Greenhouse curtain systems

are called shades, screens and even blankets. No matter what they are called, they consist of movable panels of fabric or plastic film used to cover and uncover the space enclosed in a greenhouse. Curtains may cover an area as small as a single bench or more than an acre. Small systems are often moved by hand, while large systems are commonly motor driven.

Internal shade systems mount to the greenhouse structure below the rigid or film covering of the house. They are used for heat retention, shade (and the cooling effect of shade) and day length control or blackout when the covering material transmits less than 1% of the incident light.

Advancements in drive system and shade cloth technology have made moveable exterior curtain systems practical in the 1990s. Exterior systems are used in two ways. In some cases, the curtain replaces the greenhouse covering, while in others the system is installed above a standard greenhouse structure.

Typical applications of the first type of system are to provide a hardening-off area or to add seasonal square footage in jurisdictions where zoning restrictions make it difficult to permit and build a traditional structure. The second type of outdoor system provides shade for light intensity control and blocks the light before it enters the greenhouse, giving an improved cooling effect.



22. ÁBRA. *Összetett hőszigetelésű HYDROSOL fóliasátor*

Boilers


38
KG 13
PARADICSOM

Heat-pipes with „fins”


GARDENA

Building a simple plastic film tunnel

Forcing the aluminum arches into the soil

Bringing the arches to the right level

Connecting an arch to the ridge

Wrapping up the clips
(to protect the plastic film)

The complete frame,
made from aluminum pipes

Ditching round the frame for
fixing the plastic film

Pulling up and fixing the plastic film

Preparing the door (ironing)

Soilless cultivation

Soilless Cultivation is the modern way of growing vegetables and herbs.
It can be described as growing plants in water using mineral nutrient solutions.
In nature, the roots of the plants absorb their nutrients from soil. It's not the soil itself that is essential, but the mineral nutrients absorbed from the water in the soil that essential for plants to grow.

With **soilless growing** these minerals are added to the water supply of the plant to let them grow in optimal conditions.
When growing plants in this way, all nutrients the plants need are given in the right amounts exactly when the plant needs them. By doing does the plants are always in top shape. When cultivating on soil it is far more difficult to achieve this. In soilless cultivation everything is balanced for an optimal result. This way the roots don't have to spill energy to search for nutrients in the soil, which leads to **bigger, better vegetables and a faster production**.


A1
B1
A2
B2



POTASSIUM NITRATE
POTASSIUM NITRATE
MONOPOTASSIUM PHOSPHATE