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# Ecological Influences on Ornamental Protected Cultivation: Understanding Environmental Dynamics

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All plants need an appropriate environment for good health and growth. Based on the season, environmental monitoring and control are done. Crop yield mainly depends on the responses of plants to environmental influences. The inside environment is influenced by factors such as temperature, light, humidity and carbon dioxide concentration. Protected or greenhouse cultivation is based on improved technology of growing crops in a controlled environment (the microclimate of the plant is conveniently controlled according to the needs of the plant for optimal growth, development and yield). These crops are protected from abiotic (temperature, sun, rain, wind, air and relative humidity) and biotic (diseases and pests) factors. Greenhouse used for growing (walk-in) plants in partially controllable environments comprising a superstructure covered with transparent or translucent plastic materials. Horticultural cultivation in greenhouses has obvious advantages in terms of quality, productivity and favorable market prices for producers, while reducing the price of vegetables in unfavorable environmental conditions (summer and rainy seasons, cyclones, epidemics and swarms of 'insects) and controlling viruses transmitted by insects. Disease that cannot be controlled in the open field or under natural growing conditions. It regulates prices on the vegetable market.

**Temperature:-** Temperature has a considerable influence on crop timing and yield. Temperature has a direct impact on physiological development phases and regulates the transpiration rate and plant water status through stomata control during photosynthesis. Average temperature is 20-30°C, with approximate lower and upper temperature limits of 10°C and 35°C. If the average minimum outside temperature is below 10°C, it requires heating, particularly at night. If the average maximum temperature exceeds 27–28°C, then artificial cooling is necessary.

**Shading:-** Nets are more effective in hot and sunny regions.Shading screens have two main objectives, *viz.*, to decrease light intensity and to provide shade in order to reduce radiation input and prevent heat build up. Shading can be done by provision of internal or external shade screens, paints and shade nets.

**Cooling System:-** In tropics and sub-tropical regions especially in plains and coastal regions in our country needs cooling during hot summer. The temperature inside GH (4 – 10 °C) higher than outside atmosphere. Reducing temperature in hot and warmer days is prime important. Greenhouse air temperature crosses the upper limit of the crop tolerance, result in either partial or total crops failure with a short period of time.

**1. Fan and pad system**:- A small stream of water runs over the pad continuously and air is drawn through the pad by the fans, absorbing heat and water vapor in the poly-house. Reduction in air temperature 12°C even under very high ambient temperatures.

**2. Fog Cooling:** -Uses fog containing water droplets of less than 40 micron size for cooling. Fog nozzles are fixed above through a separate pipeline arrangement above the plants and heated air leaves through the above ventilators.

**3. Mist cooling:** -Water droplets are bigger in size. Proper management need to prevent diseases.

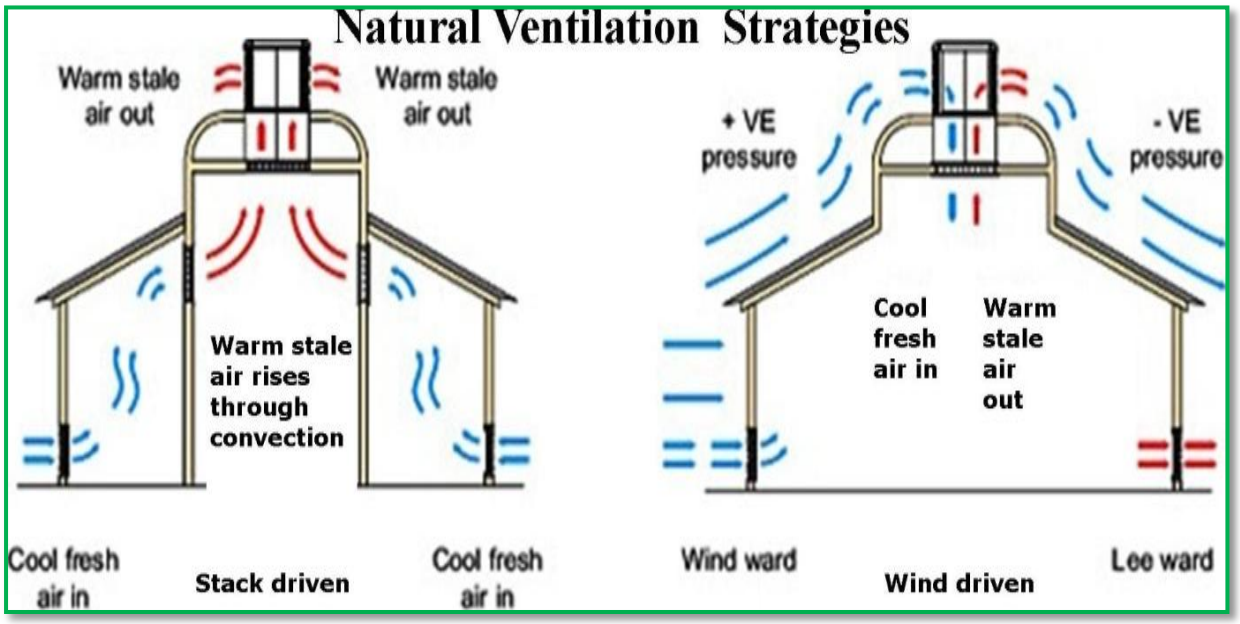
**4. Roof shading:** -Use of shade screens such as saran cloth, polypropylene, polyester, cloth shades and shade nets.

**5. Ventilation:** -Ventilation is the exchange of air between the greenhouse and its surrounding. Different types of ventilations used for cooling:

a. Natural ventilation or passive ventilation.

b. Forced ventilation or Active ventilation.

**Natural Ventilation:** -Natural or passive ventilations are also called open circuit ventilation. Where in the ambient air replaces the enclosed air of greenhouse through vents. The side walls and the vents along the roof tops serve as openings for natural ventilation.




**Forced ventilation:** It is also called active ventilation or closed circuit ventilation or mechanical ventilation. In this system auxiliary power is used to move air through the greenhouse.

**Two Types:**

1. Exhaust or forced air ventilation system .
2. Evaporative cooling or Fan & cool cell pad cooling system.

**Ventilation through Nylon nets:** The inlet provided at the lower level near ground i.e. 1-2 meter, height opening on all sides, but covered with 40-60 nylon mesh insect proof net. Provided with roll able UV resistant LDPE film all along the side walls to regulate temperature. The out let provided at the base as well as near the roof level. For larger polyethylene structures, natural ventilation at roof level is most effective.

**Greenhouse Heating System:** Heating is necessary in places like the temperate region and hilly zones where the temperature is very low. In some places where the climate is extreme, both heating and cooling may be necessary. Steam, hot water, infrared, and solar rays are the four ways of heating a green house. Pipe heating is the most common green house heating system. It is a network of metal or plastic pipes distributing steam or hot water.

Types Of Greenhouse Heating System:-

1. Boiler
2. Unit heaters
3. Infra red heaters
4. Solar heaters

**1. Boiler:** A centralized system of heating. Fuel for the boiler: coal or fuel oil. The heating is done through hot water at 85°C or steam at 102°C. Water or steam pipes are installed above the beds of crops and along the side wall.

**2. Unit heaters:** The system in which warm air is blown from unit heaters that have self-contained fireboxes. Heaters are located throughout the poly-house. Each heating system has a floor area of 180 to 500 $m^2$.

**3. Infrared heaters:** The fuel gas (LPG) is burned, and the fumes at a temperature of about 480°C are passed in 10cm diameter pipes kept overhead at a height of 1.5m above plants. Reflectors are provided over the full length of pipe to radiate the infrared rays over the plants. The plants and soil only get heated without much air heating. The infrared heating pipes can be provided at 6 to 10 meter intervals. The temperature of fume gases at present is about 65°C, and an exhaust fan is provided for maintaining the flow of fumes.

**4. Solar heaters:** Flat-plate solar heaters are used to heat the water during the day. The hot water is stored in the insulated tanks and circulated in pipes at night. Supplementary or emergency heating systems are provided for heating during cloudy or rainy days.

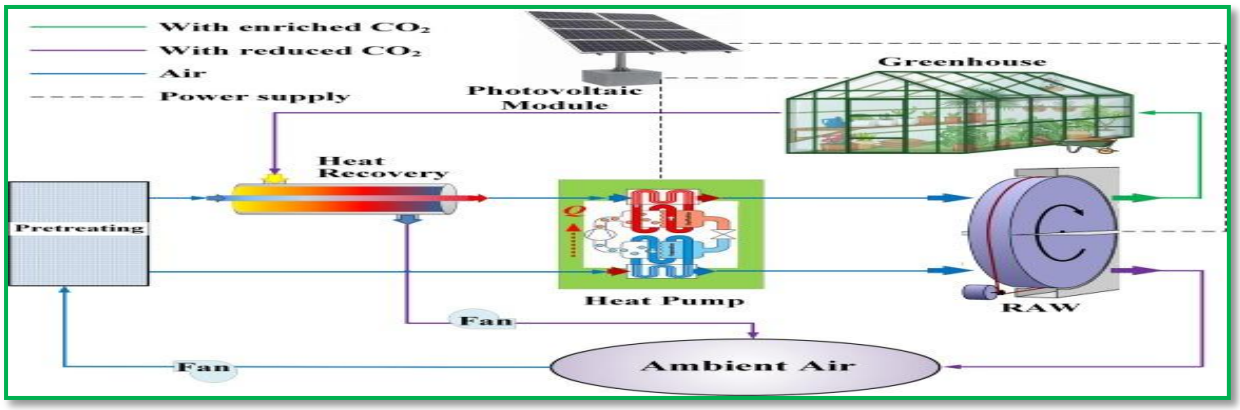
**Relative Humidity:** Light and temperature, RH is also one of the important environmental factors. Humidity is also related to temperature; if humidity is kept close to saturation, plant have been noticed to survive beyond 50°C. Higher humidity levels are believed to raise the fungal disease problem. Under low humidity is associated with wilting and symptoms of senescence.

**Factors influencing humidity inside the green houses: -**

**1. Outside climatic factors:-** Outside moisture content, Air temperature, Solar intensity, etc.

**2. Inside factors:** Ventilation, Rate of air movement, Transpiration rate, Moisture content, inside temperature, Air vapor pressure deficit etc.

**$CO_2$ Enrichment:-** The $CO_2$ enrichment is defined as "$CO_2$ fertilization", which has been implemented in plant cultivation to enhance their growth for many years. $CO_2$ enrichment can be done by three methods *viz.*, $CO_2$ burner, Pure $CO_2$, Fuel gases. A $CO_2$ chamber has an open combustion chamber in which gas is burned. A fan causes a strong air current passing into the combustion chamber and distributes the produced heat into poly-house. The liquid $CO_2$ gas is available in bulk, stored in pressure cylinders. The advantages are no harmful effect by products (like ethylene).




**Light Management:** During the growth of plants, the required sources of the light are provided by either the sun or artificial lights. Under low light conditions during the winter months, the use of artificial lighting is necessary to promote plant growth. In summer, short-days are achieved artificially by covering the plants for part of each day with a black cloth to promote blooming.

**Climate Requirement of Flower Crops under Controlled Conditions**

| S.No. | Crop | Day (°C) | Night (°C) | RH (%) | Light intersity |
|---|---|---|---|---|---|
| 1. | Anthurium | 22-25 | 18-20 | 70-80 | 20000-25000 Lux |
| 2. | Carnation | 16-20 | 10-12 | 50-60 | 21.5 k for Atleast 5 hrs / days |
| 3. | Chrysanthemum | 18-21 | 10-16 | 60-65 | 35000-40000 Lux |
| 4. | Gerbera | 22-25 | 12-16 | 60-65 | 40000-50000 Lux |
| 5. | Orchid | 15-25 | 10-15.5 | 70-80 | 200-800 foot candles |
| 6. | Rose | 24-28 | 15.5-16 | 60-65 | 10000-12000 Foot candle |