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Center for Smart Agriculture

Protected floriculture



Module 2: Components Pre-requisites for protected cultivation of flower crops

Session 8: Equipment required for controlling green house environment



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Introduction

- The objective of environmental control is to maximize the plant growth.
- The control of greenhouse environment means the control of temperature, light, air composition and nature of the root medium.
- Five stages in this evolution include manual controls, thermostats, step-controllers, dedicated microprocessors and computers.



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Active summer cooling systems

- Achieved by evaporative cooling process.
- It is developed to reduce the problem of excess heat in green house. In this process cooling takes place when the heat required for moisture evaporation is derived from the surrounding environment causing a depression in its temperature.
- In the evaporative cooling process the cooling is possible only up to the wet bulb temperature of the incoming air.



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Active summer
cooling systems

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graph TD; A[Active summer cooling systems] --> B[Fan-and pad system]; A --> C[Fog systems];
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Fan-and pad
system

Fog systems



Fan and Pad cooling system

Has been available since 1954

The pad is composed of a cross-fluted cellulose material

Exhaust fans are placed on the opposite wall.

Fog cooling system

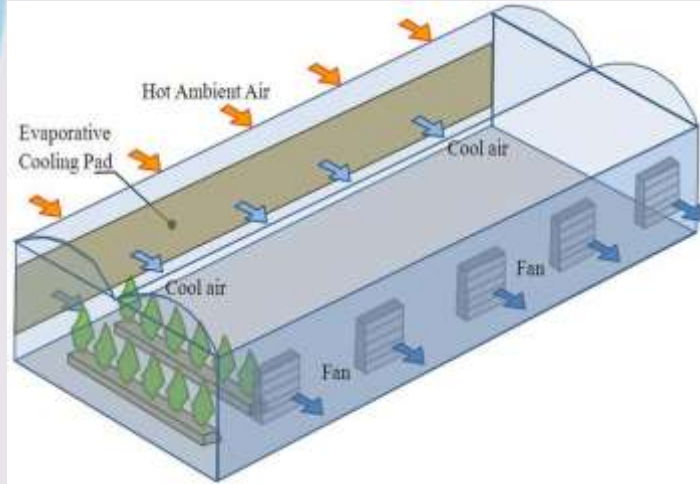
Introduced in green houses in 1980

Fog containing water droplets with a mean size <10 microns using suitable nozzles is generated.

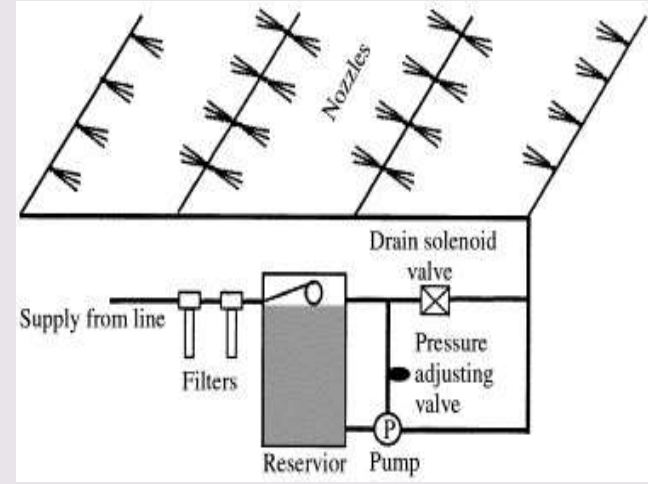
There is less scope for disease and pest attack



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Fan and Pad cooling system



Fog cooling system



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Active winter cooling systems

- The actual process in winter cooling is tempering the excessively cold ambient air before it reaches the plant zone. Otherwise, hot and cold spots in the green house will lead to uneven crop timing and quality .
- This mixing of low temperature ambient air with the warm inside air cools the green house in the winter.



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Active winter
cooling systems

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graph TD; A[Active winter cooling systems] --> B[Convection tube cooling system]; A --> C[Horizontal air flow (HAF) fan cooling system];
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Convection tube
cooling system

Horizontal air
flow (HAF) fan
cooling system



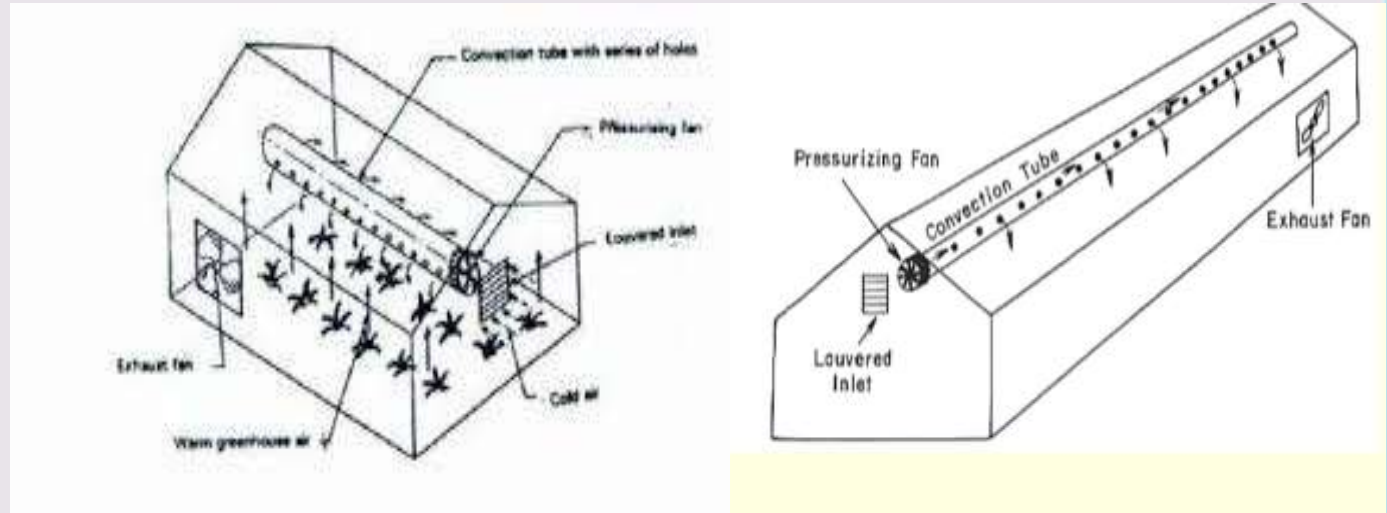
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Convection tube cooling

- In this system, the cold air mixes with the warm greenhouse air well above the plant height. The cool mixed air, being heavier gently flows down to the floor level, effects the complete cooling of the plant area. The pressurizing fan forcing the incoming cold air in to the convection tube must be capable of moving at least the same volume of air as that of the exhaust fan, thereby avoiding the development of cold spots in the house. The process minimizes the temperature gradient at difference levels. The circulation of air using convection tube consumes more power than a circulation system.



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Convection tube cooling



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Horizontal air flow (HAF) cooling

- An alternative to convection tube for the air distribution.
- Temperatures at plant height are more uniform with HAF system than with convection tube system. It makes use of the same equipments and controls as the convection tube system. Cold air entering through the louvers located at the higher level in the gables of the green house is drawn by the air circulation created by the network of HAF fans and to complete the cycle, proper quantity of air is let out through the exhaust fans. The combined action of louvered inlet, HAF fans and the exhaust fans distribute the cold air throughout the greenhouse.



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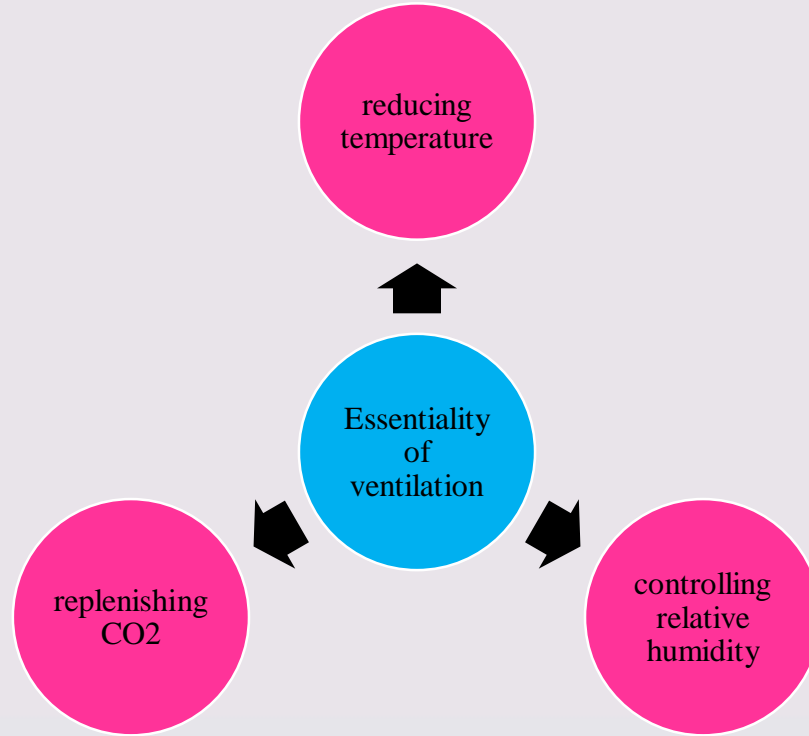
Horizontal air flow (HAF) cooling



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Greenhouse ventilation

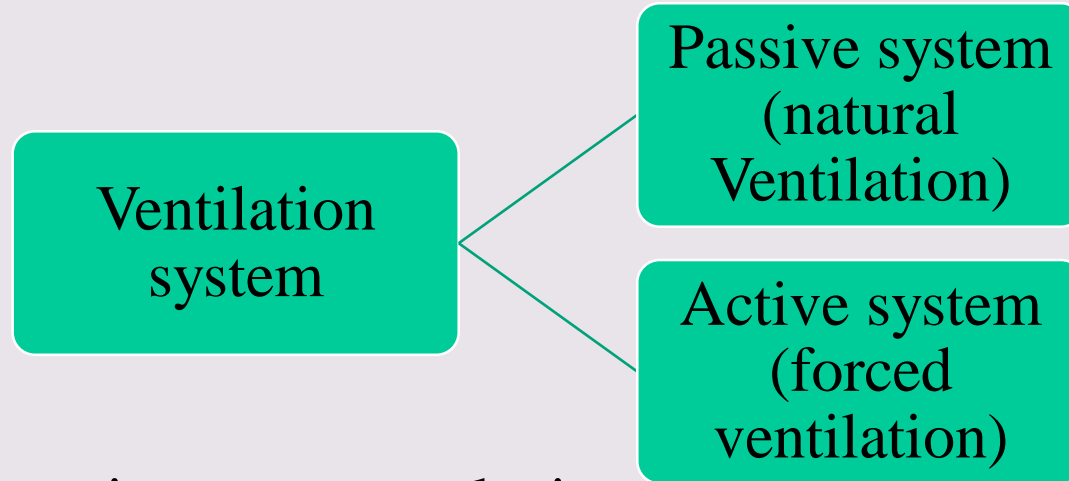
- Ventilation is the process of allowing the fresh air to enter in to the enclosed area by driving out the air with undesirable properties.





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Cont.....



A poor maintenance results in

- ❖ less crop production
- ❖ low quality
- ❖ low income



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Natural ventilation

- The sides of greenhouse structures are often left open for natural ventilation.
- Ventilators were located on both roof slopes adjacent to the ridge and also on both side walls of the greenhouse. During winter cooling phase, the south roof ventilator was opened in stages to meet cooling needs. In summer cooling phase, the south ventilator was opened first, followed by the north ventilator.
- On hot days, the interior walls and floor were frequently injected with water to help cooling.



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Roll up side passive ventilation in polyhouses

- In roll up method of ventilation, allowing the air to flow across the plants. The amount of ventilation on one side or both sides may be easily adjusted in response to temperature, prevailing wind and rain. During the periods of excessive heat, it may be necessary to roll the sides up almost to the top.
- Rollup side passive ventilation on plastic greenhouses is only effective on free standing greenhouses and not on gutter connected greenhouses.



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Roll up side



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Forced Ventilation

- In forced or active ventilation, mechanical devices such as fans are used to expel the air. This type of ventilation can achieve uniform cooling. These include summer fan-and-pad and fog cooling systems and the winter convection tube and horizontal air flow systems. For mechanical ventilation, low pressure, medium volume propeller blade fans, both directly connected and belt driven are used for greenhouse ventilation. They are placed at the end of the greenhouse opposite to the air intake, which is normally covered by gravity or motorized louvers.



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Forced Ventilation



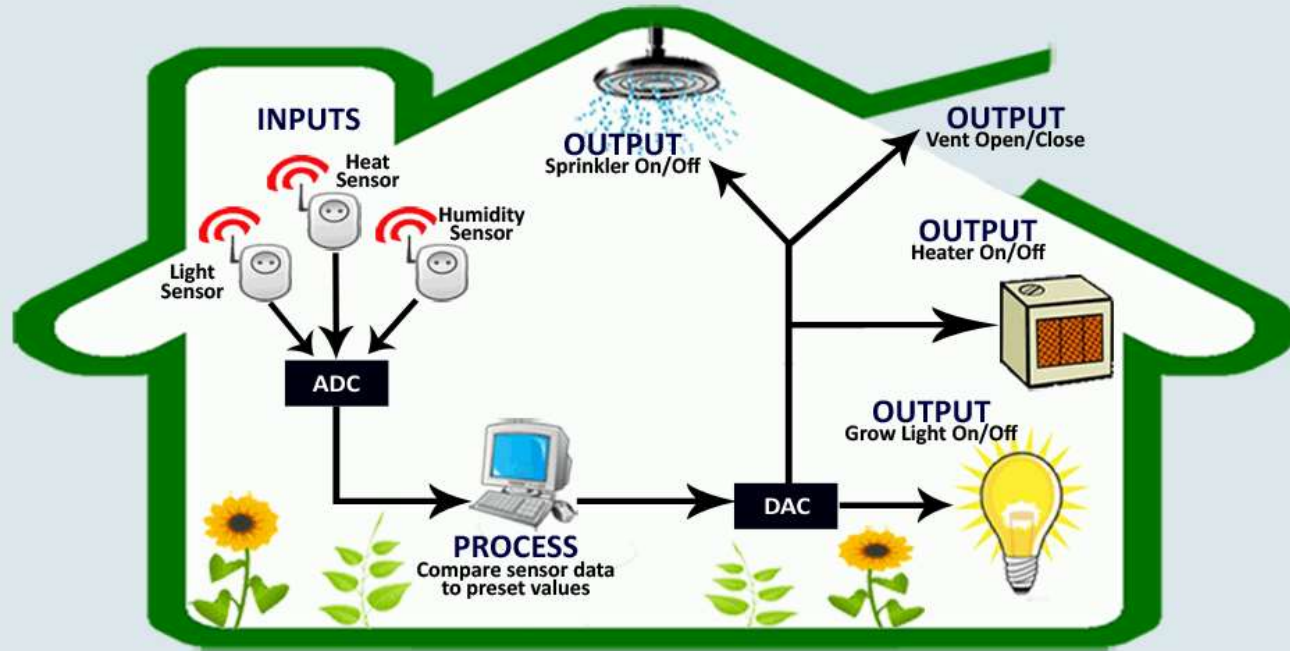
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Microprocessors

- Dedicated microprocessors can be considered as simple computers. A typical microprocessor will have a keypad and a two or three line liquid crystal display of sometimes 80-character length for programming. They generally do not have a floppy disk drive. They have more output connections and can control up to 20 devices.
- They can receive signals of temperature, light intensity, rain and wind speed.
- They permit integration of the diverse range of devices, which is not possible with thermostats.



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Microprocessors



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Computers

- Computer systems can provide fully integrated control of temperature, humidity, irrigation and fertilization, CO₂, light and shade levels for virtually any size growing facility.
- Precise control over a growing operation enables growers to realize saving of 15 to 50% in energy, water, chemical and pesticide applications.
- Computer controls normally help to achieve greater plant consistency, on-schedule production, higher overall plant quality and environmental purity.



- **Advantages**
- Can coordinate these systems to provide the optimum environment.
- Can record the environmental data and provide a history of the cropping period.
- Can control several remotely located greenhouses.
- Can anticipate weather changes and make adjustments in heating and ventilation systems.
- Can be programmed to sound an alarm if conditions become unacceptable to and to detect sensor and equipment failure.



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Disadvantages

- High initial cost investment.
- Requires qualified operators.
- High maintenance, care and precautions are required.
- Not economical for small scale and seasonal production.



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