

PLANT ENVIRONMENT AND GREENHOUSE CLIMATE

(4)

A plant grows best when exposed to an environment that is optimal for that particular plant species. The aerial environment for the plant growth can be specified by the following four factors:

- i) Heat or temperature
- ii) Light
- iii) Relative humidity
- iv) Carbon dioxide

While plants have precise optimum environmental conditions for best growth, most are tolerant to variations in these conditions within some limits. However, permanent damage would occur when they are exposed to conditions outside these limits. At the same time, plants are subject to attack by pests and diseases.

Greenhouse crop production provides protection against adverse environmental conditions and allows pests and diseases to be excluded or controlled. Besides providing a protective enclosure, a greenhouse also acts as a 'heat trap'. It admits solar radiation and converts this energy into heat by raising the temperature of the greenhouse air. While this is the basis of the greenhouse's ability to perform its tasks, it also affects other environmental factors.

Environmental conditions inside the greenhouse can be modified suiting to the potential growth of plants. The extent of climate modification will, however, depend on the design of greenhouse and is generally related with its cost. Higher the capability of greenhouse to modify its climate, higher is the cost of its construction.

The way in which a greenhouse gets heated when exposed to sunlight is similar to heating of the earth's surface and its adjacent atmosphere. When solar radiation reaches the earth, a small portion is reflected back into the space while the remainder is absorbed at the surface raising its temperature. In the same way, when solar radiation reaches the greenhouse cover- surface, a small amount (normally 15-20%) is reflected back from the surface while the remainder is transmitted to the interior. Plants, soil and other objects absorb most of this transmitted radiation and remainder is reflected. The absorbed radiation raises the temperature of absorbing surfaces and objects with the heat energy being immediately transferred to the greenhouse air by convection and evaporation thereby increasing the temperature and humidity.

Greenhouses lose heat in three ways:

- i) Warm air moves out the greenhouse and is replaced by cooler outside air.
- ii) Heat is transferred through the covering material itself.
- iii) Heat is lost through the soil / floor.

Increasing the temperature of the growing environment in a greenhouse is unavoidable, but it is also the most important function of a greenhouse. Enhanced temperatures accelerate plant growth, and allow sustaining plant growth even when outside ambient temperatures are unfavourably low. However, during summers, inside

temperatures rise higher than the optimum levels and, therefore, cooling/ventilation provisions are necessary.

Most plants grow better within 60 - 85% relative humidity (RH) of air. Low RH increases the evaporative demand on the plant, while high RH can depress this demand inhibiting the uptake of nutrients, particularly of calcium. In general, the RH inside the greenhouses is higher than the outside, mainly due to transpiration load. Effective ventilation is required to control higher RH levels.

LOW COST STRUCTURES

(5)

Advantages:

- Ideal for small holders farmers-simple and affordable
- Suitable for hotspot areas eg. Flood plains
- Profitable
- Low water utilisation
- High quality production of vegetables

Some low cost structures are:

1. Plastic low tunnels
2. Insect Proof Net house
3. Naturally ventilated greenhouse

Plastic low tunnels- Plastic low tunnels are flexible transparent coverings that are installed over single or multiple rows of vegetables to enhance the plant growth by warming the air around the plants in the open field during winter season when the temperature is below 10⁰c. Plastic low tunnels are often used to promote the growth of plants during the period of winter season. Low tunnels are supported above the plants by using hoops of GI wire and a clear or transparent plastic of 30-50 micron is covered/stretched over the hoops and the sides are secured by placing in soil. The plastic is vented or slitted during the growing season as the temperature increase within the tunnels. The farmers can grow different varieties of summer squash (round fruited, long fruited) which is a emerging crop along with cultivation of netted muskmelon varieties in place of traditional varieties. Bitter gourd and round melon are two other crops with increasing demand and which usually fetches very high price during off-season and can be grown successfully by using the plastic low tunnel technology.

Insect Proof Net houses- Insect proof net houses can be made by covering all sides and top with insect proof net of 40 or 50 mesh, but the net should be UV stabilized. Under these net house crops like sweet pepper, tomato chilli or okra can be grown successfully without infestation of viruses or other insects like fruit borer etc. and the growers can save the huge amount spent on pesticides. Cost is Rs 80-100/m².

Naturally ventilated greenhouse-Naturally ventilated greenhouses are the protected structures where no heating or cooling devices are provided for climate control. These are simple and medium cost greenhouses which can be erected with a cost of Rs.500-600 sq. meter and these greenhouses can be used successfully and efficiently for growing year round parthenocarpic slicing cucumber, off season muskmelon, tomato and sweet pepper crops for 6-7 months duration. These structures are having a manually operated cross ventilation system as and when required.

Others-Low cost polyhouses can also be erected by using GI pipes of 1.0 and 1/2 inch. The 1.0 inch pipe is useful erecting the side walls upto 6-7 feet in height and on the top the 1/2 inch size bended GI pipes are fixed in the 1.0 inch size pipes. The width of these structures is 5 to 5.5 feet. The top of the structure is covered with plastic of 180-200 micron, whereas the sidewalls are first covered with insect proof net of 40 or 50 mesh up to 5-6 feet height from the ground after placing it in soil and a rollable plastic is fixed over the net. During summer one can roll the all side plastic for cross ventilation in the structure and it can be opened during the winter season to increase the inside temperature of the structure. These structures can be used for off-season or virus free cultivation of vegetable or for year round virus free healthy nursery raising of different vegetables. These structures can be made within Rs. 100-110 per m² cost and the farmers themselves can made these structures according to their requirement.

ORIENTATION AND CONSTRUCTION

(6)

Selection of site for Greenhouse:

Following things are taken into account

1. The selection Site should be free from pollution.
2. Water should be available regularly
3. Supply of electricity (Three phase) should be regular
4. Soil should be properly levelled and drained
5. Poly house should be near to road side means proper approachable road must be there to go to poly house
6. Some space should be there nearby for further extension
7. Expertise and labours should be available when required.

Greenhouse Orientation

- In a free-standing greenhouse, more sunlight is available in winter in an east-west oriented greenhouse
- A freestanding greenhouse should have its long axis perpendicular to the wind direction
- In multi-span greenhouses, the gutter should be oriented north south
- In naturally ventilated greenhouse, the ventilators should open on the leeward side.

Basic Design Considerations

Functional design parameters:

- Light transmission
- Crops
- Size of operation
- Environmental control requirements
- Frame material
- Glazing material

Structural design: The most important function of the greenhouse structure and its covering is the protection of the crop against hostile weather conditions (low and high temperatures, snow, hail, rain and wind), diseases and pests. The different structural designs of greenhouse based on the types of frames are available. The ultimate design of a greenhouse depends on the following aspects: (i) The overall structural design and the properties of the individual structural components. (ii) The specific mechanical and physical properties which determine the structural behavior of the covering materials. (iii) The specific sensitivity of the crop to light and temperature to be grown in the greenhouse. (iv) The specific requirements relevant to the physical properties of the covering material. (v) The agronomic requirements of the crop.

TRAINING AND PRUNING METHODS IN PROTECTED CULTIVATION

(7)

Training:

When the plant is stalked or tied or supported over a trellis or pergola in certain fashion or some of its parts are removed or trimmed with a view to give the plant a particular shape, this operation is called training.

Training refers to judicious removal of part to develop a proper shape of plant capable of bearing heavy crop load.

Objectives:

- Controls shape of plants.
- Proper distribution of fruit bearing parts
- Control of insect & diseases
- Facilitate interception of sunrays to each and every part of plant.
- Develop balance between vegetative and reproductive growth of plant.

Principles:

- Training should be started from very beginning age of plant
- In plant having prominent apical dominance, terminal bud should be removed to facilitate emergence of side branches.
- Drooping branches need to be removed.

Pruning:

Removal of any excess or undesirable/unproductive branches, shoots or any other parts of plant so as to allow the remaining part to grow normally or according to desire of pruner is called pruning.

Judicious removal of parts like root, leaf, flower, fruit, etc. to obtain good and qualitative yield.

Objective:

- To control flowering and fruiting.
- To remove diseased, damaged, insect infested part of plant
- To remove weak shoots.
- To thin out flower and fruits
- To augment production in plant which bear on new shoots.
- It ensure access to sunlight to bearing shoots.

Principle of Pruning:

- Pruning should be completed well in advance of flowering season.
- Apply Bordeaux paste after pruning to avoid incidence of disease.
- Diseased, damaged and insect infested shoots should be removed
- Avoid injury to plant while pruning.

Training and pruning in tomato:

Tomato plants are pruned to single stem by removing all the lateral shoots, which is commonly referred as suckers. Allowing the suckers to grow and bear fruit would be small and of poor quality. It is better to have one main stem that bears fruit as this will produce larger, more uniform and higher quality fruits. Removing the laterals once per week will keep them under control. It is advisable to leave one or two of small sucker at the top of the plant. A support system of wires above the crop should be rigged. The wire should run parallel to direction of rows. When the plant reaches wire height it is leaned and dropped.

Cluster pruning will also improve size and uniformity .This involves removing small fruits from some cluster, leaving three, four or five of the best ones. Remove misshaped and deformed fruits first. Otherwise remove the smallest fruit which is usually the last one formed on each cluster.

Training and pruning in cucumber:

Cucumbers are often trained on a string or wire system. Umbrella system is best for seedless varieties. Other systems are tree trellis system, over head vertical line trellis system.