Quadrant II – Transcript and Related Materials

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Module Name: Green House and Mist Chamber

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Notes

Introduction

Different types of plant propagation structures are used in nursery management. The structures which facilitate propagation of plants are called propagation structures and are necessary for propagating plants by seed, cuttings and grafting. Framed structures such as green house, mist chamber, shed roof and shade house are some important structures. About 92% of cultivated plants are grown in the open field. Since the beginning of agriculture, farmers have had to cope with the growing conditions given to them by nature. In some of the temperate regions where the climatic conditions are extremely adverse and no crops can be grown, man has developed technological methods of growing some high value crops by providing protection from the excessive cold and excessive heat. This is called Greenhouse Technology. Greenhouse Technology is the science of providing favourable environmental conditions to the plants. It also protects the plants from wind, cold, precipitation, excessive radiation, extreme temperature, insects and diseases. An ideal micro climate can be created around the plants.

Greenhouse

A greenhouse is a framed, infrastructure covered with a transparent material in which crops are grown under at least partially controlled environment. Various designs of greenhouse viz., shade net house, plastic film green house,

glass house and natural greenhouses may be designed as per the need and resource availability.

Types of greenhouses

Greenhouses are constructed to meet the specific needs. Different types of greenhouses based on shape, utility, material and construction are briefly given below:

Greenhouse type based on shape

For the purpose of classification, the uniqueness of cross section of the greenhouses is considered. The commonly followed types of greenhouses based on shape are:

Lean to type greenhouse: Greenhouse is placed against the side of an existing building. It is built against a building, using the existing structure for one or more of its sides. It is usually attached to a house or to other buildings. The roof of the building is extended with appropriate greenhouse covering material and the area is properly enclosed. The lean-to type greenhouse is limited to single or double-row plant benches with a total width of 7 to 12 feet and it can be as long as the building it is attached to. It should face the best direction for adequate sun exposure.

Even span type greenhouse: It is the standard type and full-size structure, the two roof slopes are of equal pitch and width. This design is used for the greenhouse of small size, and it is constructed on level ground. It is attached to a house at one gable end. It can accommodate 2 or 3 rows of plant benches. The height varies from 2.5 to 4.3 m.

Uneven span type greenhouse: This type of greenhouse is constructed on hilly terrain. The roofs are of unequal width; make the structure adaptable to the side slopes of hill.

Ridge and furrow type: Designs of this type consists of two or more A-frame greenhouses connected to one another along the length of the eave. The eave serves as furrow or gutter to carry rain and melted snow away. The side wall is eliminated between the greenhouses, which results in a structure with a single large interior, consolidation of interior space reduces labour, lowers the cost of automation, improves personal management and reduces fuel consumption since there is less exposed wall area through for heat escape.

Saw tooth type Greenhouse

These are also similar to ridge and furrow type greenhouses except that, there is provision for natural ventilation in this type. Specific natural ventilation flow path develops in a saw- tooth type greenhouse.

Quonset greenhouse: In this type of greenhouse; the pipe arches or trusses are supported by pipe purling running along the length of the greenhouse. The covering material used for this type of greenhouses is polyethylene. These houses are connected either in free, standing style or arranged in an interlocking ridge and furrow. In the interlocking type, truss members overlap sufficiently to allow a bed of plants to grow between the overlapping portions of adjacent houses.

Greenhouse type based on utility

Classification is based on the functions or utilities. Among the different utilities, artificial cooling and heating are more expensive and elaborate. Hence based on this, they are classified as:

i) Greenhouses for active heating: During the night time, air temperature inside greenhouse decreases. To avoid the cold bite to plants due to freezing, some amount of heat has to be supplied. The requirements for heating greenhouse depend on the rate at which the heat is lost to the outside environment. Various methods are adopted to reduce the heat losses, viz., using double layer polyethylene, thermo pane glasses (Two layers of factory sealed glass with dead air space) or to use heating systems, such as unit heaters, central heat, radiant heat and solar heating system.

ii) Greenhouses for active cooling: For effective crop growth, it is necessary to reduce the temperatures of greenhouse than the ambient temperatures during summer season. Hence suitable modifications are made in the green house so that a large volume of cooled air is drawn into greenhouse. This type of greenhouse either consists of evaporative cooling pad with fan or fog cooling.

Greenhouse type based on construction

The construction is influenced by structural material, though the covering material also influences the type. Higher the span, stronger should be the material and more structural members are used to make sturdy tissues. Based on construction, greenhouses can be classified as:

i) Wooden framed structures: For the greenhouses which has span less than 6 m, wooden framed structures are used. Side posts and columns are constructed of wood without the use of a truss. Pine wood is commonly used as it is inexpensive and possesses the required strength. Timber locally available, with good strength, durability and machinability also can be used for the construction.

ii) Pipe framed structures

Pipes are used for construction of greenhouses, when the clear span is around 12m.The side posts, columns cross ties and purlins are constructed using pipes. In this type, the trusses are not used.

Greenhouse type based on covering material

Covering materials are the major and important component of the greenhouse structure. Covering materials have direct influence on the greenhouse effect inside the structure and they alter the air temperature inside the house. The types of frames and method of fixing also varies with the covering material. Based on the type of covering materials, the greenhouses are classified as glass, plastic film and rigid panel greenhouses.

i) Glass greenhouses

Only glass greenhouses with glass as the covering material existed prior to 1950. Glass as covering material has the advantage of greater interior light intensity. These greenhouses have higher air infiltration rate which leads to lower interior humidity and better disease prevention. Lean-to type, even span, ridge and furrow type of designs are used for construction of glass greenhouse.

ii) Plastic film greenhouses

Flexible plastic films including polyethylene, polyester and polyvinyl chloride are used as covering material in this type of greenhouses. Plastics as covering material for greenhouses have become popular, as they are cheap and the cost of heating is less when compared to glass greenhouses. The main disadvantage with plastic films is its short life. For example, the best quality ultraviolet (UV) stabilized film can last for four years only. Quonset design as well as gutter-connected design is suitable for using this covering material.

iii) Rigid panel greenhouses

Polyvinyl chloride rigid panels, fibre glass-reinforced plastic, acrylic and polycarbonate rigid panels. are used as the covering material in the quonset type frames or ridge and furrow type frame. This material is more resistant to breakage and the light intensity is uniform throughout the greenhouse when compared to glass or plastic. High grade panels have long life even up to 20 years. The main disadvantage is that these panels tend to collect dust as well as to harbour algae, which results in darkening of the panels and subsequent reduction in the light transmission.

Structural components for greenhouse construction

In structural components, rafter is the primary vertical supporter of greenhouse. Rafters are generally placed on 2, 3 or 4 foot centers based on the energy requirements to hold the whole structure. It may be truss, curved or arch type depending on the greenhouse width. Purlins provide horizontal supports that run from rafter to rafter. All the structural components are spaced 4-8 feet apart based on the magnitude of the greenhouse. Purlins used in high winds area to provide additional support, connected by a cross tie. Side posts and columns provide vertical supports usually ranging in high point from 1-10 feet. These structural components determine the height of the production area. Sidewalls placed to provide cooling, insulation by proper ventilation.

Framing Materials: Aluminium, steel and wood framing materials are popularly used for construction of greenhouse. However, out of these three, aluminium is the most durable and economical. They are available in different shapes and thicknesses. This framing material can be modified into rafters, side posts and other structural components. Framing material like wood is not used frequently as it deteriorates quickly in the mist facility of greenhouse. If wood is used, it is good to obtain pressure treated lumber that “resists” decompose. There are adequate framing materials treated wood available commercially.

Covering Materials: Greenhouse covering materials should be clear enough to provide optimum light transmission and long lasting as well as inexpensive. A huge number of materials have been availed on a commercial basis to meet these needs. Glass materials are good for best light transmission for greenhouse crop production but the structural components used to support

glass are very costly. Covering material fibreglass is more long lasting and does not need the substantial structural components as required in glass house. It is used frequently on commercial basis. Fibreglass is more sensitive to ultra violet (UV) light, allows less light transmission as the fibre get swell. Double sheets of polyethylene (PE) film, filled with air, is one of the most popular non rigid covering materials on traded greenhouses, give support required for normal operation. Recently available polyethylene (PE) film lasts two years and it needs to be supplanting after the durable time. Although maintenance of these covering materials is expensive, the lower starting investment as well as the less structural components required to hold up this covering materials, has made it most economical for consumer as well as producers. A large number of new polycarbonate and acrylic covering materials are now available for greenhouse

Plants grown in greenhouse includes Gerbera, Rose, Chrysanthemum, Carnations, Anthurium, Lily, Orchids and vegetables such as Colour Capsicum, Cucumber, Tomato, Strawberry, etc.

Mist Chamber

Mist chamber is a structure used in a nursery to propagate leafy soft-wood cuttings. Difficult to root plants and shrubs can root successfully under mist. In Mist Chamber, the ideal temperature range is 22-35°C. Relative humidity is maintained at high level (95 %) with the help of mister's, which spray water under high pressure. Size of mist partials lies between 50 to 100 µm.

The principal is to spray the cuttings with a minimum quantity of water to maintain the desired humidity level. High relative humidity facilitate better root initiation and cooling effect prevents the cutting from drying out.In this way, the rate of transpiration is reduced to a minimum and as result the guard cells remain turgid. The stomata remain open, and the manufacture of carbohydrates and related substances proceeds unabated even in presence of high light intensity. Further, with the high light intensity, the evaporation of water from the leaves keeps the tops relativity cool, and this in turn lowers the rate of respiration. Thus, with the low rate of transpiration combines with the low rate of respiration, other manufactured substances become available for the initiation and growth of the root system. The frequency of misting depends upon ambient temperature and type of plant material being propagated. Mist beds are constructed within a greenhouse. A fine mist is sprayed intermittently over the cutting at regular intervals during day and night. The mist unit is

controlled by a time clock, operating a magnetic solenoid valve and is set in a way to turn on the mist for 3-5 seconds to wet the leaves and turn off for some time and when the leaves are dry the mist is again turned on.

There are two types of Misting:
i) Continuous: The continuous involve applying the mist continuously during the light period

ii) Intermittent: Intermittent system involves applying the mist at definite intervals during the light period.

Control mechanisms of mist: Mist has five control mechanisms:
i) Timer ii) Electronic leaf iii) Thermostat and timer iv) Screen balance and v) Photoelectric cell.

i) Timer: Two types of timers are used in a mist unit one turns on in the morning and off at night and second operates during day hours to produce an intermittent mist, usually 60 seconds 'On' and 90 seconds 'Off'.
ii) Electronic leaf: A plastic with two terminals is placed under the mist along with cuttings, the alternate drying and wetting of the terminal breaks off the current, which in turn controls the solenoid value.
iii) Thermostat: Controls the temperature of mist.
iv) Screen balance: It consists of a stainless-steel screen attached to a lever with mercury switch. When mist is on water is controlled on the screen and when weight is more, it trips the mercury switch.
v) Photoelectric cell: It is based on the relationship between light intensity and transpiration rate.

Precautions
i. There should be regular supply of water.

ii. The pH of water should be in the range of 5.5 to 6.5, avoid hard and alkaline water, as it blocks the nozzles.

iii. Rooting media should have good aeration.

iv. Keep mist chamber free from the growth of blue green algae.

Advantages

1. Supply of plant material throughout the year, which is not possible in open field cultivation.

2. Reduce the rate of moisture loss from the plants, thereby helping in survival of root-cuttings as well as for hardening of tissue cultured plants. Thus, the main advantage of mist chambers is to avoid the desiccation or drying out of the plant material.

3. Planting material remains devoid of any susceptibility to pathogen, insect and pest's attack.

Disadvantages

1. Hardening of rooted cuttings is more difficult and requires careful attention. Selection of right medium is very important.

2. Under mist conditions oxygen deficiency can create problem.

Plants which are propagated in mist chamber includes Eucalyptus, Casuarina, Bamboos, etc.