

Unit



Introduction to Protected Cultivation

INTRODUCTION

Protected cultivation is a process of growing crops in a controlled environment. This means that the temperature, humidity, light and such other factors can be regulated as per requirement of the crop. This assists in a healthier and a larger produce. There are various types of protected cultivation practices. Some of the commonly used practices are — forced ventilated greenhouse, naturally ventilated polyhouse, insect-proof net house, shade net house, plastic tunnel and mulching, raised beds, trellising and drip irrigation. These practices can be used independently or in combination, to provide favourable environment to save plants from harsh climate and extend the duration of cultivation or off-season crop production. Adoption of drip irrigation under raised beds (you will read about it in Unit 4) covered with mulch films not only eradicates weeds but also maintains moisture in the soil for a prolonged period by minimising evaporation losses.



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SESSION 1: IMPORTANCE OF PROTECTED CULTIVATION

Although agriculture has been the backbone of India's economy since ages, yet our experience during the

Do you know?

Greenhouse effect

When short wave radiation from the Sun enters the greenhouse structure, it refracts through the surface and gets transformed into long wave radiations. These long wave radiations do not escape the greenhouse in entirety, thereby trapping the heat and thus, continually increase the temperature inside. This is known as the greenhouse effect. Thus, the enclosed space builds higher temperature than the ambient environment. However, after sunset it starts losing stored heat through conduction, convection and radiation.

last 50 years indicates a relationship between the agricultural practices, its growth *vis-à-vis* economic well-being. The trend of agricultural growth points towards a mix of appreciable achievements on the one hand and missed opportunities on the other. If India has to remain self-sufficient and provide food security to the poor while also being able to export high quality fruits and vegetables, new and effective production technologies are required which can continuously improve the productivity, profitability and respectability of the agricultural sector. One such area is the protected cultivation technology, which is being widely practiced in the developed countries, but its use in India is limited.

The wide variations in the climatic conditions across the diverse topography through the length and breadth of the country allow a large number of cropping patterns. India also experiences climatic extremes such as floods, droughts and other climatic abnormalities that cause crop losses regularly or damages resulting in economic losses to the farmers. Simultaneously, the demand for quality agricultural produce has increased over the last decade. This provides better opportunities for the Indian farmers to adopt protected cultivation technologies as per region and suitability of the crops.

Greenhouses are being commercially used for production of exotic (non-native) and off-season vegetables, export-quality cut flowers and also for raising quality seedlings. Economic returns from the high value agricultural produce can be increased substantially when grown under greenhouse conditions. For the crops under protected environment, the use of chemical pesticides and insecticides can be kept minimal to avoid their residues on the crop produce. Greenhouses are mostly used as rain shelters, particularly in high rainfall areas of India such as North-eastern states and coastal regions.

Objectives of Protected Cultivation

- (i) Protection of plants from abiotic stress (physical or by non-living organism) such as temperature, excess/deficit water, hot and cold waves, and biotic factors such as pest and disease incidences, etc.



- (ii) Efficient water use with minimum weed infestation.
- (iii) Enhancing productivity per unit area.
- (iv) Minimising the use of pesticides in crop production.
- (v) Promotion of high value, quality horticultural produce.
- (vi) Propagation of planting material to improve germination percentage; healthy, uniform, disease-free planting material and better hardening.
- (vii) Year-round and off-season production of flower, vegetable or fruit crops.
- (viii) Production of disease-free and genetically better transplants.

At present in India, the small and medium farmers have started flower and vegetable cultivation under different types of modular protected structures depending upon their investment capacity and availability of market in their area. Among all the protected cultivation practices, greenhouse cultivation provides maximum benefits. The major crops grown under protected structures include — floriculture crops like rose, gerbera, carnation, anthurium, lily, orchids, chrysanthemum, etc., and the vegetable crops like tomato, yellow and red bell peppers (from the capsicum family), cucumber, leafy and exotic vegetables, etc.

Limitations of Protected Cultivation

- (i) High cost of initial infrastructure (capital cost).
- (ii) Non-availability of skilled human power and their replacement locally.
- (iii) Lack of technical knowledge of growing crops under protected structures.
- (iv) All the operations are very intensive and require constant effort.
- (v) Requires close supervision and monitoring.
- (vi) A few pests and soil-borne pathogens are difficult to manage.
- (vii) Repair and maintenance are major hurdles.
- (viii) Requires assured marketing, since the investment of resources like time, effort and finances, is expected to be very high.

Scope of Protected Cultivation

As per the National Horticultural Database of the year 2014–15, Tamil Nadu ranks first in area under flower



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cultivation followed by Karnataka, and West Bengal. The share of floricultural products in the export of total horticultural produce is 3.2 per cent. At present the share of Indian floriculture products in international market is about 0.6 per cent. According to (APEDA) data, in the year 2016–17, India's total export of floriculture was Rs 548.74 crores. Dry flowers alone contribute around 70 per cent revenue of the total floricultural export. India has a share of 10 per cent of the total global dry flower market. There are over 300 export-oriented Floriculture Units in India, mostly located near Mumbai, Pune, Bengaluru, Hyderabad and New Delhi, which have good facility for export of live plant material for producing and exporting flowers to the developed countries. The export-quality flowers include bulbs, cut and loose flowers, dry flowers, ornamental plants and cut foliage, which are most suited for greenhouse cultivation. Besides this, greenhouse technology holds promise for marginal farmers for higher productivity and quality through high technology based agriculture.

While greenhouses did exist in one form or the other for more than one-and-a-half centuries in various parts of the world, the use of greenhouse technology started in India only during 1980s mainly for research activities, after India had achieved self-sufficiency in foodgrain production. After the 'Green Revolution', some of the ill consequences like extensive use of chemicals in fertilisers and pesticides of intensive agriculture became evident.

Besides the government's efforts, globalisation has given a boost to the export of agricultural produce, which has played a role in the increased demand for greenhouses in most parts of the country.

Commercial production of floriculture exists in Maharashtra, Tamil Nadu and Karnataka, which cater to the demands of both domestic and foreign markets. From 1988 onwards, these ventures have been specialised further to achieve a technological edge involving development of greenhouses. These have



improved further post-1991 India when Indian economy was liberalised. At present, the private sector has established 100 per cent export-oriented units. These efforts have been quite successful in meeting export standards for the regularity of supply, quality and hence acceptability in offshore markets. Exports have achieved very promising results in terms of the acceptance of quality standards in major foreign markets.

Table 1.1: Crops Grown under Protected Cultivation

Flowers	Chrysanthemum, Carnation, Gerbera, Rose, Lilium, Orchid, Gladiolus, etc.
Vegetables	Tomato, Coloured Capsicum (Yellow and Red Bell Peppers), Cucumber, Broccoli, Red Cabbage, Leafy vegetables, Radish, etc.
Fruits	Strawberry
Seedling and Nurseries	Vegetables, Flowers, Tissue Culture, Clonal for Forestry, Fruit Grafting (like Lemon, Citrus, Mango, Pomegranate, Guava, Litchi, etc.)

The Government of India executes various schemes for protected cultivation at the central and the state levels to popularise these high-tech plant growing techniques. National agencies through their leading schemes *viz.* National Horticulture Board (NHB), National Horticulture Mission (NHM), Mission for Integrated Development of Horticulture (MIDH) and *Rashtriya Krishi Vikas Yojana* (RKVY) create awareness and provide financial support to the farmers, so that protected farming for high value horticultural crops could be adopted easily.

Protected cultivation involves a complex set of practices and technologies which require elaborate planning, fabrication, management and maintenance of quality production of horticultural crops to take advantage of season, demand and choice of market. It gives opportunities for the cultivation of horticultural crops in an entrepreneurial form for the upmarkets in urban and semi-urban areas, besides empowering youth, and technology-led traditional ways of crop cultivation to such modern methods.

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Practical Exercises

Activity 1: Visit to a greenhouse farmer

Materials required: notebook, pen, pencil, etc.

Procedure: Visit and note down following information

- Collect the information about location/owner.
- Types of structure.
- Cost involved for establishment of protected structure.
- How she/he makes financial arrangement.
- Input required for establishment of polyhouse.

Check Your Progress

A. Fill in the blanks

1. Greenhouse is commonly used to produce _____ cut flowers.
2. Rain shelters are mostly used in _____.
3. Year round and off season production of flowers and vegetables is possible in _____.
4. Forced ventilated greenhouse is the type of _____.

B. Mark the correct choice

1. Protected structure protect the plant against _____.
 (a) only biotic stress
 (b) only abiotic stress
 (c) biotic and abiotic stress
 (d) water stress
2. Flower crop grown under protected cultivation
 (a) Gerbera
 (b) Jasmine
 (c) Hibiscus
 (d) Marigold
3. Use of greenhouse technology in India started in the year
 (a) 1970
 (b) 1980
 (c) 1990
 (d) 2000

C. Descriptive Questions

1. Describe the importance of protected cultivation.



2. Describe the scope of protected cultivation in India.

3. What are the objectives of protected cultivation?

D. Match the columns

A	B
1. Protected Cultivation	a. Less productivity/unit area
2. Open Cultivation	b. Temperature stress
3. Shed net house	c. High productivity/unit area
4. Greenhouse effect	d. Protected structures

SESSION 2: SITE SELECTION AND SUITABLE CROPS FOR PROTECTED CULTIVATION

While protected cultivation practices such as drip irrigation, raised bed farming, mulching can be practised on any site, even where cultivation is still being done. The criteria for site selection in case of protected cultivation structures like shade net houses and greenhouses are as follows:

- (i) Exposure to ample sunlight: The site should not be near tall trees, buildings or by the leeward side of hills.
- (ii) Appropriate distance from a low-lying area: The site should not be in an area prone to waterlogging.
- (iii) Levelled ground surface: A slope of 0–2 per cent is recommended. Levelling is required to be done in case the slope is beyond the recommended range. For steep terrains, it is recommended to build several separate greenhouses with axes parallel to contour lines.
- (iv) pH and electrical conductivity of soil: It should have a pH of 6.0–6.5 and electrical conductivity should be less than 0.5 dS/m.



dS/m (deci Siemens) indicates the amount of salts present in the soil (K^+ , Ca^+ , Mg^+ , Na^+ , Cl^- , HCO_3^-). Excess amount of salts hinder plant growth and/or can affect infiltration (becoming a part due to filtration).

Mulch is a protective covering (of sawdust, compost, plastic sheet spread or left on the ground) that is used to reduce evaporation, maintain even soil temperature, prevent erosion, control weeds, enrich the soil or to keep it clean.

- (v) Availability of continuous source of good quality water in sufficient volume: The approximate water requirement is $1-2\text{ l/m}^2/\text{day}$, which can be adjusted based on the season and the stage of cultivation.
- (vi) pH and electrical conductivity of water: The pH and electrical conductivity of irrigation water should be in the range 6.5–7.0 and less than 0.7 dS/m respectively.
- (vii) Continuous supply of electricity: This is particularly necessary during the day time.
- (viii) Good transportation facilities: This is important to enable the transportation of greenhouse produce to nearby markets in time.
- (ix) Availability of sufficient land for future expansion: A gap of 10–15 m should be maintained between two greenhouses, considering the possibility of expansion in future.
- (x) Easy availability of labourers in surrounding area: This should also be kept into consideration. Usually, four labourers are required for flower cultivation in a one-acre greenhouse.
- (xi) Good communication facilities: These should be available at the site.
- (xii) Plantation of windbreaks: The plants that breaks the flow of the wind from a particular direction. These plants are tall and have strong root base. These include poplar, silver oak, casuarina, etc., which are planted on the western side about 20 m away from the greenhouse because west winds are the strongest.
- (xiii) Awareness of relevant occupational safety and health standards.

Greenhouse Orientation

In a single span or multi-span naturally ventilated polyhouse, the orientation of the structure is in the North–South direction and all roof vents face East, except the last bay, which is in the opposite direction. Also, in a naturally ventilated polyhouse or shade net house, 40:60 ratio, i.e., 40 per cent width (East to West) and 60 per cent length (North to South) is kept for better



ventilation, though this ratio is based on the wind load on the North–South wall, in high speed wind zones. If the wind speed is high in an area, the length of the structure is restricted within 55 m in the North–South direction. However, in single or multi-span shade net houses, the longest dimension should be in the East–West direction. In this context, the direction of planting beds is also important and has to be done perpendicular to the arc of the Sun movement through the day.

In open fields, all crop varieties like self-pollinated and cross-pollinated vegetable crops can be cultivated under drip irrigation, raised bed and mulching. However, while selecting the vegetable crops for shade net house and greenhouses, self-pollinated varieties must be selected or at least there should be proper arrangement and expertise for artificial or aided pollination. It is important to note that such restrictions do not apply to flower cultivation. The major flower crops cultivated in greenhouses are — rose, gerbera, carnation, chrysanthemum, liliun, orchids, etc. These crops are propagated either by grafting or based on tissue culture or cuttings.

The varieties are developed by the plant breeders and are mostly patented. The seed propagated varieties are mostly first-generation hybrids. The commercial vegetative propagations of the other crops are done mostly by private firms using tissue culture method. The duration of the crop varies with the type of crop. The crops grown in greenhouse can be cultivated in the soil organic or artificial media.

tissue culture: the growth in an artificial medium of cells derived from living tissue

Major Flower Crops and their Varieties Cultivated under Greenhouses

Rose

The commonly cultivated varieties of rose are as follows.

- Standard rose: This variety bears large-sized buds with long stalk. It has good commercial value for long distance markets due to its higher shelf-life.
- Sweet heart rose: This variety bears small-sized buds with short stalk.



Fig. 1.1: Rose

- Spray rose: The plants of this variety bear five to six buds.

The roses grown in greenhouse could be of different colours and combinations such as red, yellow, white, pale green, pink, orange and their different shades. Some of the commercially available varieties of rose are Gold-strike, Grand gala, Noblesse, Revival, Bordeaux and Avalanche.

Gerbera



Fig. 1.2: Gerbera

Almost all the gerbera plants cultivated in greenhouses in India are commercially tissue cultured varieties and are multiplied and distributed by various private firms. The commonly grown colours of gerbera are white, red, pink, yellow, orange and twin shades.

Some of the commercially available varieties are — North Star, Ornella, Paradox, Tropic Blend, Topaz and Pink Fantasy.



Fig. 1.3: Cultivation of Carnation

Carnation

The commonly cultivated varieties of carnation are as follows.

- Standard carnation: This variety bears longer branches with bigger buds.
- Spray carnation: This variety bears shorter branches and small flowers.

Chrysanthemum

It is one of the commonly preferred cut flowers and potted plants in the domestic and international market.

It stands tremendous scope. Private and small entrepreneurs and progressive growers can give impetus to the efforts to develop non-traditional export products to suffice the agricultural sector for earning the much needed foreign exchange. Boost for the commercial production of chrysanthemum will replace import quantity with local production. Selection of chrysanthemum varieties depends on the location and objective of the growers *vis-à-vis* the variations grown *viz.*

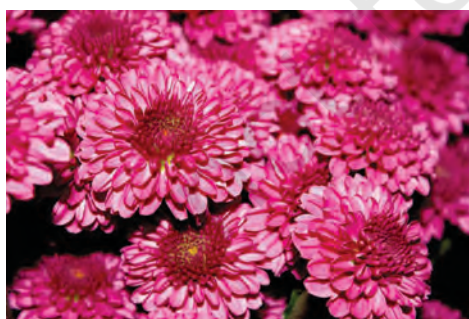


Fig. 1.4: Chrysanthemum



Otome (white and pink), Taiwan Yellow, Bowl of Gold, Taiwan White, Golden Princess Anne, etc. For potted chrysanthemum, the varieties grown are Kikubiyori, Snowball, Genie, La France, Rhapsody, Red Headline, Miss Hiroshima, Algiers, Capistrano, Autumn Fire, etc.

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Practical Exercises

Activity 1: Visit to a polyhouse and record criteria for site selection.

Materials required: notebook, pen, etc.

Procedure

- Visit the place with prior appointment.
- Observe road connectivity, wind breakers, electricity, skilled labour availability, etc.

Activity 2: Visit to a greenhouse flower cultivator and discuss about crops and varieties.

Materials required: notebook, pen, pencil, etc.

Procedure

- Identify the greenhouse flower grower in the nearby area.
- Visit these sites in consultation with the farmer(s).
- Discuss with the farmer on crop cultivation practices and advantages of protected cultivation as perceived by the farmer.
- Assess the need of promoting a particular type of the crop grown in a greenhouse.
- Discuss problems associated with greenhouse.

Check Your Progress

A. Fill in the blanks

1. The soil pH should range between _____ for effective greenhouse cultivation.
2. The gap between one greenhouses to another should be minimum _____ m.
3. Number of labour required for flower cultivation in one acre greenhouse are _____.
4. Under greenhouse condition _____ pollinated type of varieties are suitable.
5. Longer branches with bigger bud size varieties of carnation are known as _____.

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B. Mark the correct choice

1. The direction of single span greenhouse should be
 - (a) East–West
 - (b) North–South
 - (c) North–East
 - (d) South–West
2. The windbreaks should be kept in the _____ direction
 - (a) Eastern
 - (b) Western
 - (c) Northern
 - (d) Southern
3. What is the ratio of width and length in shade net house?
 - (a) 40:60
 - (b) 20:10
 - (c) 15:25
 - (d) 20:80

C. Descriptive questions

1. Write important criteria for site selection in protected cultivation.

2. Which type of roses can be cultivated in protected structures?

D. Match the columns

A

1. Gerbera
2. Spray roses
3. Mulch
4. Chrysanthemum

B

- a. Bear five to six buds
- b. A protective cover
- c. Taiwan yellow
- d. Pink Fantasy

