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Poly House Structures and Their Management

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Abstract
Polyhouse cultivation is the concept of growing potential crops in the modified natural environment for ensuring optimum growth of the crop plants without any or least stress and hence offers great scope to harness this potential of growing the high value crops by achieving independence of climate and weather, and to grow these crops during off -season and in marginal environments. Globally, there is a need to increase productivity and quality of the produce to meet the demand of ever-increasing quality and health-conscious consumers. Most vegetable growers are growing vegetables in conventional technique in their fields. During vegetables cultivation many diseases and insect's incidence occurs in their crops in different stages and damaged the vegetable crops and deteriorate the quality. For the management of pests and disease growers are applying the insecticide indiscriminate ways. Resulting they are getting low yield and poor quality. Growers get low return due to high expenses in pesticide during vegetable production. Present days, it has been proved that growing of vegetables under protected cultivation techniques will give higher yield with best quality and growers can get higher return per unit area. But due to some constraints, this technology has not become popular among the vegetable growers. Keeping this in view, the initial cost of protected structures is higher but it is compensated in 3-5 years with the good production of crops. Financial support or 50 % to 90 % subsidy is also provided by the state Governments. So that protected cultivation techniques can be easily popularized for the benefit of the vegetable growers for higher returns.

Keywords: Polyhouse, Controlled, Structures, Vegetables, Management

Introduction
With globalization of markets, shrinking land and climate change, the protected cultivation of high value crops has emerged as the single most important technology for ensuring:
- High productivity
- Improved quality and
- Profitable returns

Historical Perspective
- Protected cultivation on commercial scale is undertaken in over 50 countries across the globe.
- First modern greenhouses were built in Italy in the thirteenth century.
- In India, green house technology started in 1980 and initially it was used for research only.
- In India, first polyhouse was designed and set up in 1985 at Leh (J & K).
- In Ladakh, greenhouses are being built for extending the growing season of vegetables from 3 to 8 months.

- In India greenhouse cultivation is mainly in Maharashtra, Karnataka, Uttarakhand, J&K.

What is Poly House?

- A poly-house is a type of greenhouse structure that is made of polyethylene or other similar materials.
- It is designed to provide a controlled environment for plants, allowing for their cultivation in regions where the climate is not suitable for their natural growth (Janick *et al.*, 2007)
- Poly-houses are used in agriculture for a variety of purposes, such as growing vegetables, fruits, flowers, and other crops.

Need of Polyhouse Cultivation

- Higher yield
- Year-round cultivation
- Better quality
- Off-season production
- Assured production
- Generate self-employment for the educated rural youth in the farm sector
- Least pesticide residues
- Controlled pollination
- Vagaries of weather
- Easier plant protection
- Weed free cultivation Need of Protected Cultivation

Present Scenario

- Around 115 countries in the world are growing vegetable in greenhouse.
- The world scenario demonstrates the area under protected cultivation to be approximate 623.30 thousand ha while the total estimated world greenhouse.
- vegetable production area was 402.98 thousand ha. Of the aggregate world greenhouse vegetable area, account for 95 thousand ha (Hickman *et al.*, 2011).
- Sabir and Singh (2013) observed that in India, the area under protected cultivation in 2012-13 around 25 thousand ha while the greenhouse vegetable cultivation area is about 2000 ha. Punera *et al.*, (2017) concluded that, in Himachal Pradesh the area under protected cultivation promoted by National Horticulture Mission has been found nearly 1.5 lakh ha in 2014-15.
- At present, only ~50,000 ha are under protected cultivation in India, followed China was 2 million hectares. There is a need to increase 4 times the area (~2,00,000 ha) under protected cultivation in the next 4-5 years.
- Production under protected cultivation not only providing high water and nutrient use efficiency but it can easily increase

Worldwide Total Area in Major Greenhouse Production Countries

Country	Area (Ha)
China	2,760,000
Korea	57,444
Spain	52,170
Japan	49,049
Turkey	33,515
Italy	26,500
Mexico	11,759
Netherlands	10,370
France	9,620
United States	8,425

Source: Kacira (2011)

productivity and production by 3-5 folds over open/outdoor field cultivation.

❖ The total production of vegetables under protected cultivation is 138 million tons at present and to be increased to 250 million tons by the year 2024-2025 which may be achieved through bringing additional area under vegetable crops, using hybrid seeds, use of improved agro-techniques like protected structures. (Sindhu and Chatterjee, 2020).

Potential Crops for Poly-House Cultivation

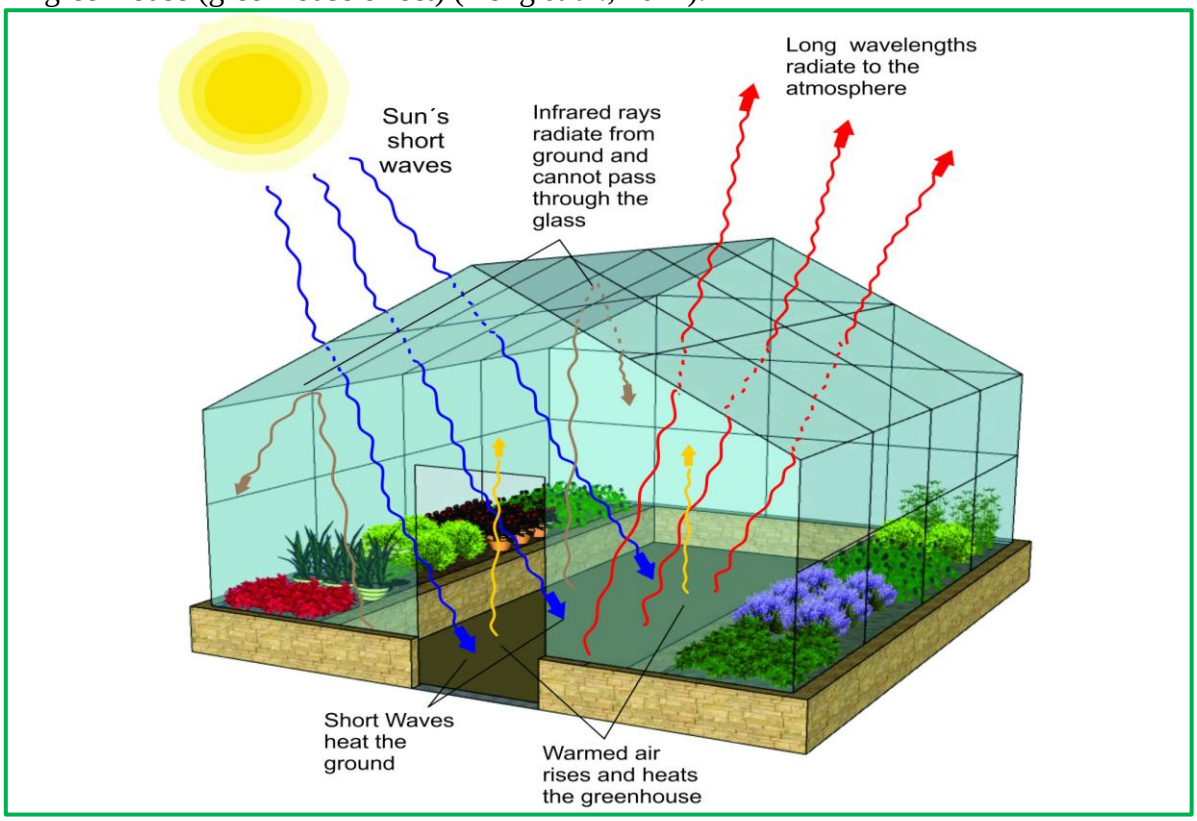
- Greenhouse technology is more suited to vegetables crops (such as tomato, capsicum, cucumber, French bean, cabbage, chillies, spinach, cauliflower etc.)
- Flowers (like rose, gerbera, carnation etc.) and nursery for all vegetable crops, because of their small life-span.
- This technology is mainly suitable for commercial farming, as it requires investment in setting up the entire framework.

Principle of Polyhouse

❖ Greenhouses are structures covered with transparent material such as polythene or glass.

❖ The covering acts like a selective radiation filter and allows short wave length solar radiation to pass but traps the long wave length radiation.

❖ The long wave radiations emitted by the plants and objects in the greenhouse cannot pass through the covering material owing to its lesser transparency for it. This results into rising of the temperature inside the greenhouse due to trapped solar energy inside the greenhouse (greenhouse effect) (Hong *et al.*, 2017).



Advantages and disadvantages of protected cultivation

Advantages	Disadvantages
• Manipulation of Growing season. • Production volume increases more than 10-12 times than normal production. • Round the year production of most desired crop. • Disease and pest attack is minimum. • Suitable for rearing/hardening of tissue culture plants. • Latest technologies can be incorporated to get maximum benefits.	• Initial cost is very high. • Knowledge of various factors are required to effectively control climate inside the greenhouse.

Site Selection

- A good site can make all the difference in the functional and environmental operations of a polyhouse.
- The soil should have pH of 5.5-6.5
- Availability of continuous source of quality water.
- The pH of the irrigation water should be 5.5-7.0
- Good supply of electricity.
- A ground slope for drainage is an important factor to divert surface water way from the green house.
- Greenhouses should be located away from the buildings and trees to avoid obstruction to sunlight and should be pollution free.
- Facility of good road transport to near markets.
- Easy and cheap availability of labourers.
- Communication facility should available at site.

Orientation of the Greenhouses

- Orientation of the greenhouses could be in any direction when they are in single spans.
- Multi-span greenhouses should be oriented in north-south direction only, to avoid continuous shading of certain-portions of the greenhouse by its structural members.

Comparison of Different Kinds of Covering Materials

S. No.	Type	Durability	Transmission		Maintenance
			Light	Heat	
1.	Poly ethylene	One year	90%	70%	Very high
2.	Poly ethylene UV resistant	Two years	90%	70%	High
3.	Fiber Glass	Seven years	90%	5%	Low
4.	Tedlar coated Fiber Glass	Fifteen years	90%	5%	Low
5.	Double strength Glass	Fifty years	90%	5%	Low
6.	Poly carbonate	Fifty years	90%	5%	Very low

Types of Polyhouses

- Low cost or naturally ventilated polyhouses
- Medium cost or Partial climate-controlled polyhouses
- High cost or Fully climate-controlled polyhouses
- Plastic low tunnels
- Net houses
- Plastic mulches

Low cost or naturally ventilated polyhouses

- Low initial investment.
- Constructed with locally available material such as bamboo, timber etc.
- No specific control devices for regulating environmental parameters inside the polyhouse.
- Suitable during cold weather, especially in hilly areas.
- Warranty for 3 years from the date of installation for structure.
- Crops grown capsicum, cabbage**.**

Medium Cost or Partial Climate Controlled Polyhouses

- The structural frame is made up of galvanized iron pipes.
- Exhaust fans are used for ventilation, these are thermostatically controlled.
- Cooling pad is used for humidifying the air entering the polyhouse
- These are suitable for vegetable cultivation during mild winter and mild summer.
- Warranty for 5 to 7 years from the date of installation for structure.
- Crops grown tomato, bell pepper.

High Cost or Fully Climate Controlled Polyhouses

- Consists of sensors.
- Acrylic panels or polycarbonate panels.
- Frame is made up of iron or aluminium
- Polyethylene film 3-6 mil thick
- Designs are dome shaped or cone shaped
- These are highly durable, 5-6 times costlier
- Growing medium used in these types of greenhouses are Peat, Perlite, Vermiculite, Rock wool.
- Fertigation and pesticide sprays are done by fogging machine.
- Warranty for 10 years from the date of installation for structure.
- Crops grown spinach, broccoli, lettuce, strawberry, etc.

Plastic Low Tunnels

- Miniature form of polyhouse.
- Protect the plants from rains, winds, low temperature, frost and other vagaries of weather.
- Provide the best way for off season vegetable nursery production by modifying the microclimate around the plants.
- Nursery bed of size 3x1x0.15 cm.
- A portable low plastic tunnel of size 3.5x1.20x1.0 m size with polythene sheet of 120 GSM is put on the nursery bed.
- Seedlings germinate faster and their hardening is done simultaneously by removing the portable tunnels during day time or when the weather conditions is favourable.
- Can be transported from one place to another with ease.
- Crops grown cucumber, watermelon, bitter gourd, muskmelon etc.

Net Houses

- Simple framed structure or small row like structure.
- Nets of 40 and higher mesh are effective.
- Control entry of flying insect Save crop from viral disease.
- Netting to maintain an environment which also provide isolation from insect borne pollen.
- 3 years warranty from the date of installation for structure.
- Crops grown leafy vegetables, gerbera, roses etc.

Production Systems and Media for Protected Cultivation

1) **Soil System:** Crops grown in natural soil.

2) **Hydroponics:** The technique of growing plants using a warmer based nutrient solution rather than soil.

Disadvantages

- Presence of disease, insect and weeds in the soil.
- Excessive nutrient level could leach into ground water tables.
- Flooding of irrigation water cause high water table which reduces aeration, thereby root growth.

Climate Control

- Maintain humidity 60-80%.
- Maintain optimum temperature 18-24ºC (avoid >35 and <12ºC)
- Use agro shade net to control temperature and light
- Ensure sufficient air circulation around the plants
- Ensure carbon dioxide concentration >300 ppm

Fertigation

- Fertigation is the application of fertilizers, soil amendments, or other water soluble products through an irrigation system.

Objectives of fertigation

- Maximize profit by applying the right amount of water and fertilizer.
- Minimize adverse environmental effects by reducing leaching of fertilizers and other chemicals below the root zone.

Advantages

- Relatively uniform fertilizer application.
- Less fertilizer used.
- Reduced costs.

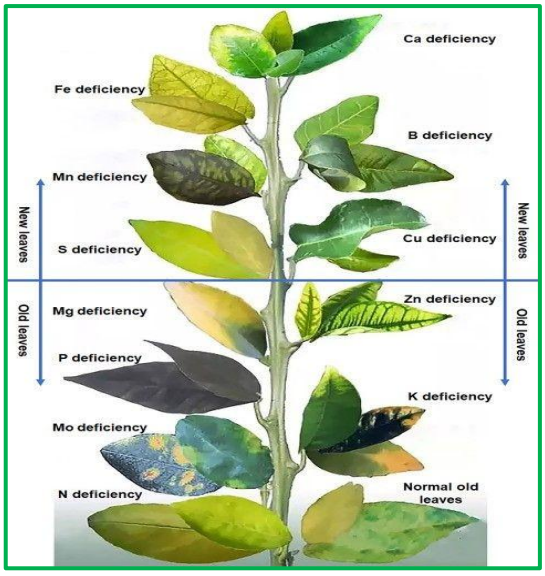
Disadvantages

- Potential contamination hazard from equipment malfunctions.
- Careful handling of liquid fertilizers required.

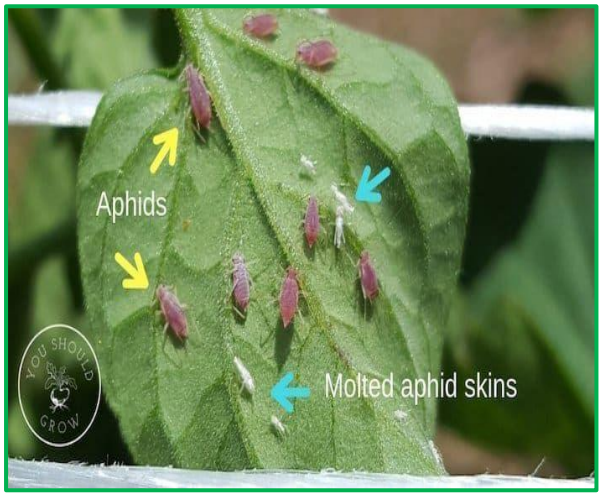
Problem management in greenhouse cultivation

The troubles which arise in the culture of crops in the greenhouse may be divided into several groups:

- Failure to supply the essential factors for optimum growth such as light, moisture, carbon dioxide and heat in amounts necessary for each individual crop.
- Fertilizer deficiencies.
- Fertilizer excesses.
- Toxic gases.
- Attacks by insects, animals, and allied pests and Susceptibility to fungus, bacteria and virus troubles.



The different insects of polyhouse and their control



Aphid can be controlled by avoiding relay croppring

White fly attack can be controlled by using sticky trap @1 trap /10m2

Wilt disease can be controlled by using Trichoderma viridae 4 gm /kg seed

Maximum Project Costs Allowed for Subsidy Calculation

A.	**Development of Commercial Horticulture ##**		
A. 2	Commercial Horticulture Development in protected cover.	Rs 112.00 lakh per project covering area above 2500 Sq.mt.	Credit linked back-ended subsidy @ 50% of cost limited to Rs.56.00 lakh per project.
	Protected cultivation		
1.	Green House structure		
	(a) Fan & Pad system	Rs. 1400/Sqm and Rs. 1610/Sqm for hilly states	50% of cost for above 2500 Sqm
	(b) Naturally ventilated system		
	i) Tubular structure	Rs. 844/Sqm and Rs.970/Sqm for hilly states.	50% of cost for above 2500 Sqm
	ii) Wooden structure	Rs. 540/Sqm and Rs. 621/Sqm for hilly states	50% of cost for above 2500 Sqm
	iii) Bamboo structure	Rs. 450/Sqm and Rs. 518/Sqm for hilly states	50% of cost for above 2500 Sqm
2.	Shade Net House		
	(a) Tubular structure	Rs. 710/Sqm and Rs. 816/Sqm for hilly states	50% of cost for above 2500 Sqm
	(b) Wooden structure	Rs. 492/Sqm and Rs. 566/Sqm for hilly states	50% of cost for above 2500 Sqm
	(c) Bamboo structure	Rs.360/Sqm and Rs.414/Sqm for hilly states	50% of cost for above 2500 Sqm
3	Plastic Tunnel	Rs.60/Sqm and Rs.75/sqm for hilly states	50% of cost for above 2500 Sqm
4	Walk in Tunnel	Rs.600/ Sqm	50% of cost for above 2500 Sqm
5	Anti-Bird/Anti Hail Nets	Rs.35/Sqm	50% of cost for above 2500 Sqm

Future Prospects

Polyhouse vegetable production in the country is still in infancy and for its rapid commercialization, there is urgent need to redress the following issues related to this technology:

1. Standardizing proper design of construction of polyhouses including cost effective and indigenously available cladding and glazing material.
2. Developing cost effective agro-techniques for growing of different vegetable crops in the different types of polyhouses and lowering energy costs of the greenhouse environment management.
3. Major research activities on growing of vegetables under protected covers should be launched by ICAR and SAU's.
4. Import of planting materials, structural designs and production technologies which are not relevant under Indian conditions should be stopped and in turn emphasis should be given to develop own F1 hybrid varieties so that seed are made available to the growers in time and at cheaper rates.

Conclusion

Protected cultivation of high value crops has become irreplaceable both from economic and environment points of view. It offers several advantages to grow high value crops with improved quality even under unfavorable and marginal environments. However, due to high training needs of the greenhouse growers and some poor quality produce with pesticide residues has been a matter of great concern. These issues can easily be addressed by integrating various production and protection practices including location specific designing and construction of the polyhouses for efficient input use. Creating awareness among the greenhouse growers for judicious use of pesticides for safe production can be instrumental in providing quality products without polluting the environment. Protected cultivation- every day farming.

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