# Sowing the Seeds of Success: Harnessing Protected Environments for Thriving Vegetable Seed Cultivation

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## Introduction

Vegetables plays an important sector contributing food nutrition in India, includes huge number of families *viz*., Solanaceae, Malvaceae, Cruciferaceae, Cucurbitaceae etc., Vegetables are edible plant parts, rich in vitamins, minerals, dietary fibers etc., and also consumed as human diet. 400g (mini) per day requirement is recommended as per FAO. Vegetables share of 60.75% among horticultural crops.

**Table 1** Area, production and productivity of vegetables seed production (2017-18)

| | Area ( ha) | Production (000 MT) | Productivity (MT / ha) |
|---|---|---|---|
| India | 10259 | 184394 | 17.00 |
| Karnataka | 486.12 | 8207.18 | 16.88 |

## Vegetable seed production under protected structures

India is the second largest producer of vegetables in the world and produced **187.47** million tonnes fresh vegetables from **10.43** million hectares and productivity **17.01** M T/ha (NHB-2018-19). The low productivity of vegetables could be attributed to the limited availability of quality seeds. The higher cost of the hybrid seed is prohibiting in the popularization of hybrids among the small farmers.

## Challenges in open field condition

- Healthy seedling rising Management of isolation Parental line seed production
- Promotion of hybrid seed production Short growing period
- Poor seed yield
- Poor seed quality and Reduced storability

## Protected Cultivation

Protected cultivation is the modification of the natural environment to achieve optimum plant growth, modification can be made to both the aerial and root environment to increase crops yield, extend the growing season and permit growth during periods of the year not commonly used to grow field crops.

**Table 2** Horticultural Statistics at a Glance, 2018

| **Vegetables** | **Area (ha)** | **Production (MT)** | **Productivity (MT / ha)** |
|---|---|---|---|
| Beans | 228 | 2277 | 9.90 |
| Bitter gourd | 97 | 1137 | 11.28 |
| Bottle gourd | 157 | 2683 | 16.38 |
| Brinjal | 730 | 12801 | 18.53 |
| Cabbage | 399 | 9037 | 22.04 |
| Capsicum | 24 | 326 | 7.10 |
| Carrot | 97 | 1648 | 16.03 |
| Cauliflower | 453 | 8668 | 18.80 |
| Cucumber | 82 | 1260 | 14.64 |
| Chilies (green) | 309 | 3592 | 11.86 |
| Okra | 509 | 6095 | 11.64 |
| Onion | 1285 | 23262 | 16.97 |
| Pointed gourd | 20 | 310 | 14.00 |
| Peas | 540 | 5422 | 9.98 |
| Vegetables | Area (ha) | Production (MT) | Productivity (MT / ha) |
| Radish | 209 | 3061 | 14.20 |
| Pumpkin | 78 | 1714 | 21.97 |
| Sweet potato | 131 | 1500 | 12.14 |
| Tapioca | 173 | 4950 | 20.89 |
| Tomato | 789 | 19759 | 24.34 |
| Others | 1580 | 22320 | 13.03 |
| Total | 10259 | 184394 | 17.00 |

## Historical Background

Discovery and development of the polyethylene polymer - 1930's, Introduction – 1950's, Full establishment of protected agriculture after World War II First use of polyethylene – 1948, The green house technology first started during the middle of 19th century in Europe.

**Scenario of Protected Cultivation**

- Use of green house for vegetable crop production in different countries
- Use of plastic low tunnels
- Use of floating mulch or row cover
- Use of plastic mulches

**Why Protected Cultivation?**

Crops could be grown under inclement climatic conditions when it is not possible to grow in open field In green houses having complete environmental control certain crops could be grown year round to meet the market demands Off- season production of nursery and crops, Early nursery and early cropping, Higher productivity, Superior quality of the produce, Efficient utilization of precious inputs like water and nutrients, Effective control against diseases, insect pests, Reduced expenditure on weed control, Hardening and acclimatization of tissue cultured plants, Hybrid vegetable seed production, Protection against heavy rains, hails, birds etc.

**Advances In Protected Cultivation**

- UV Blocking films to reduce pest infestation
- Netting with various colours intended to deter pests Use of biological control and pollinizers inside structures
- Greenhouses with reusable/recycled water systems
- High efficiency lighting, LED lighting, temperature control
- Mechanization to reduce need for labour
- Use of biological control and pollinizers inside structures

**Principle of protective cultivation**

The sunlight comes in the green house and is absorbed by the crop, floor and other objects which in turn emit long wave thermal radiation. The solar energy remains trapped in the green house. This condition of natural rise in green house air temperature is utilized in the cold regions to grow crops successfully.

**Current trends in greenhouse research in India**

**Active Centers**

IARI (New Delhi), GBPU&T, (Pantnagar), YSPUH&F, (Solan), IIHR, UAS (Bangalore), IIVR (Varanasi), TNAU., (Coimbatore), OUA&T, (Bhubneshwar), NAU, (Navsari), HAU, (Hisar), MPKV, (Rahuri), APHURS (Hyderabad), IGKV, (Raipur) etc.

**Aspects Covered**

- Varietal evaluation,
- Off season nursery Production,
- Standardization of planting time,
- Training systems,
- Cropping system studies,
- Dehydration of seeds etc.

**Table 3** Greenhouse Area in Different Countries

| Country | Area (ha) | Country | Area (ha) |
|---|---|---|---|
| Algeria | 5,000 | Israel | 2,200 |
| Australia | 600 | Italy | 18,500 |
| Belgium | 2,400 | Japan | 42,000 |
| Bulgaria | 865 | Jordan | 450 |
| Canada | 1,867 | Morocco | 3,000 |
| Chile | 1,600 | Netherlands | 9,600 |
| China | 2,20,000 | Poland | 1,500 |
| Columbia | 2,600 | Portugal | 2,500 |
| Egypt | 1,000 | Romania | 3,500 |
| England | 3,500 | Spain | 40,000 |
| France | 5,800 | South Korea | 1,00,000 |
| Greece | 4,240 | Turkey | 9,800 |
| Hungary | 5,500 | UAE | 155 |
| India | 800 | USA | 4,250 |

**Green House**

Greenhouse is a framed structure covered with glass or plastics film (transparent and translucent) in which plants are grown under the partially or fully controlled environment. The greenhouse technology has been considerable importance in better space utilization, growing crops in extreme climatic conditions and high rainfall areas. The solar radiations pass through it and trap the thermal energy inside the greenhouse, which is emitted by the objects that are kept inside, this phenomenon is known as "greenhouse effect".

**Greenhouse Cultivation – Global Scenario**

A French botanist named Charles Lucien Bonaparte (1803 to 1857) is said to have designed the first modern greenhouse in Leiden, Holland, which housed medicinal plants. There are more than 80 countries now in the world where cultivation of crops is undertaken on a commercial scale under cover. Asia, China and Japan are the largest users of greenhouses.

**Classification of Green Houses**

**Based on cladding material**

- Fiber glass greenhouse
- Single or double polyethylene film greenhouse Ordinary glass house
- Poly-carbonate house
- Ultraviolet-stable poly urethane film (PUF) poly house

**Based on structure**

- Wood green house
- Bamboo green house
- Steel green house

**Based on cost**

- Low-cost green house: no control system
- Medium cost green house: cooling and heating arrangements
- High-cost green house: auto control mechanism of heating, cooling and humidification system, drip irrigation system, *etc.*

**Based on climate control**

- High-tech or climate controlled green house
- Naturally ventilated or low-cost green house

**Climatic Controlled greenhouse**

Controlled greenhouse developed by Certhon in accordance with "The New Cultivation" and the "Pad & Fan system". For the international greenhouse horticulture sector, Certhon has developed a unique greenhouse: the Supreme Air greenhouse. An ingenious interplay of greenhouse, ventilation, cooling, and control makes it possible to create an ideal climate year-round. The ideal temperature and relative humidity are combined with low energy use and lower disease pressure.

**Climatic controlled greenhouse**

**Semi Controlled greenhouse:** Semi Controlled greenhouses were developed to save energy. Greenhouse air is cooled and dehumidified by air treatment units and returned to the greenhouse through cooling ducts. Active cooling is combined with window ventilation if temperatures are too high to be controlled by the air treatment units with limited cooling capacity. Cooling ducts are normally placed beneath the growing gutters, because placement overhead or within crops either causes loss of light or interferes with cultivation procedures.

**Plastic Low tunnels:** Low tunnels are basically mini greenhouses. They warm the soil and provide a temperate micro-climate for growing vegetables. Even though there may be snow on the ground, the temperature under the low tunnel is often just right for growing cool season vegetables such as kale, beets, and spinach.

**Status**

Climate-controlled devices are very few in the country. Solar greenhouses comprising of glass and polyethylene houses are becoming increasingly popular both in temperate and tropical regions. In early sixties, Field Research Laboratory (FRL) attempted solar greenhouse. vegetable production research and made an outstanding contribution to the extent that almost every rural family in Leh valley possesses a poly house these days. Indian Petro Chemical Corporation Ltd (IPCL) boosted the greenhouse research and application for raising vegetables by providing Ultra Violet (UV) stabilized cladding film and Aluminium poly house structures.

**Protected Cultivation Constraints**

- Basic cost and operational cost very high Irregular power supply
- Local availability and designing for different locations Cladding material quality/availability
- Lack of technical knowledge
- Lack of indigenous technology (Zone/region)
- Lack of suitable varieties / hybrids for greenhouse cultivation Exotic seeds very costly
- Poor performance of indigenous varieties
- Difficult to manage pests and dieses once its occurred

**Future strategies**

Development of need based poly house designs for different areas ensuring easy availability of U.V. stabilized plastic sheet and nets. Development of suitable varieties specifically for poly house cultivation Work on eco-friendly nutrient and pest management to be taken up Development of complete package of production practices Government incentives for popularization of the technology

**Conclusion**

Adverse climatic conditions, horticultural crop potentials, agro-inputs availability, small land holdings and increasing demand of high-quality vegetables necessitate adoption of the protected cultivation of vegetable crops. Low cost protected structures, viz., plastic low tunnels, walk-in tunnels, low-cost greenhouses are suitable for off-season vegetable cultivation and nursery raising in major

vegetable growing areas and peri-urban areas of the country. Insect proof net houses are also highly suitable for raising virus free healthy seedlings and growing pesticide free vegetables during rainy and post rainy season. Poly trenches are best suited to vegetable cultivation in the cold desert of the country. Increased productivity and off-season ability under protected conditions favor its early adoption in peri-urban areas of northern plains and hilly areas of India.

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