THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
May, 2023; 3(05), 926-930

Popular Article

Exploring Innovations in Indian Agriculture through Protected Cultivation

Sweety Mukherjee[1], Sushmita Saini[1]*, Sonali Mallick[1]
[1]Ph.D. Scholar, Division of Agricultural Extension, ICAR- Indian Agricultural Research Institute, New Delhi- 110012
https://doi.org/10.5281/zenodo.7996012

Abstract

Even though India's economy has long been based on agriculture, our experience over the past 50 years suggests a connection between agricultural practices and economic well-being. The trend of agricultural growth indicates a combination of notable accomplishments on one hand and squandered chances on the other. Furthermore, global trends like population explosion which is estimated to rise up to 9.6 billion by the year 2050, urbanization, industrialization, climate change, diminishing arable land, deteriorating soil health, toxicity and depletion of groundwater etc. are putting pressure on food systems. Thus, if India has to maintain its self-sufficiency and provide food security for the underprivileged while also being able to export high-quality fruits and vegetables, certainly innovative and efficient production techniques like protected cultivation must be widely used in order to continuously boost the productivity by extended growing seasons, profitability with optimal resource utilization, and respectability of the agricultural sector.

Keywords: Climate change, Food security, Soil health, Protected cultivation and Urbanization

Introduction

Growing crops in a regulated environment using greenhouses, shade nets and polyhouses to protect crop from adverse conditions is referred to as protected cultivation. This involves controlling the microclimatic parameters, such as temperature, humidity, light, and other elements, according to the crop's needs to create a larger and healthier produce. Different protected cultivation techniques exist, which include forced ventilated greenhouses, polyhouses with natural ventilation, insect-proof net houses, shade net houses, mulching, raised beds, trellising and drip irrigation. These techniques can be employed singly or in combination to create an environment that protects plants from harsh weather and lengthens the period of cultivation or agricultural production in the off-season. Crops

generally grown under protected cultivation include flowers (chrysanthemum, carnation, rose, orchid etc.), vegetables (tomato, bell pepper, broccoli, etc.), fruits (strawberry) etc.

Objectives of Protected Cultivation

- 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.
- Efficient use of water with minimum weed infestation.
- Increasing productivity per unit area.
- Reducing the application of pesticides.
- Promotion of horticulture products of superior value and quality.
- Year-round cultivation of fruit, vegetable, and floral crops.
- Production of genetically superior and disease-free transplants.
- Encourages modern farming with automated monitoring and controlling system.
- Livelihood diversification for farmers to access better quality and off-season markets.

Status of Protected Cultivation in India

- Approximately 25,000 ha of land in India was under protected agriculture in 2004–05 (Sabir and Singh, 2013), and that number increased to 1,50,000 ha in 2014–15 (20% of which was under polyhouse) (Punera et al., 2017).
- 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) promote protected farming for highly valuable horticultural crops and offer farmers with financial assistance.
- For the period of 2007–12, states including Andhra Pradesh, Gujarat, Maharashtra, Haryana, Punjab, Tamil Nadu, and West Bengal steadily increased the area under protected agriculture (Nair and Barche, 2014). This may be because several programmes launched by the Central and State Governments offer subsidies for the installation of protected structures.
    - In India, there are government subsidies available through the National Horticulture Mission (NHM) through which Haryana is offering a 65 percent subsidy, Punjab 50 percent subsidy, and Himachal 80 to 85 percent subsidy for the installation of polyhouses, along with a 70 percent subsidy for replacing the polysheets after at least three to five years of polyhouse construction or damage from natural disasters.

Choosing a Site for Protected Cultivation

Protected cultivation techniques like drip irrigation, raised bed farming, and mulching can be adopted even on sites where cultivation is still being done. The components of protected cultivation as shown in Fig. 1, with the following factors must be taken into consideration when choosing a location for greenhouses and shade net houses:

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published **29.05.2023**

- Abundant sunshine exposure: The location should not be close to tall structures, trees, or buildings, or on the leeward side of hills.
- Located away from a low-lying area that is susceptible to waterlogging.
- Levelled ground surface: A 0–2 percent slope is advised. If the slope is higher than what is advised, levelling is necessary. It is encouraged to construct many independent greenhouses with axes parallel to contour lines for steep terrains.
- The pH and electrical conductivity of the soil should be between 6.0 and 6.5 and less than 0.5 dS/m, respectively.
- A rough estimate of the water needed is 1-2 l/m2/day, which can be changed depending on the time of year and cultivation stage.
- Irrigation water should have a pH between 6.5 and 7.0 and an electrical conductivity of no more than 0.7 dS/m.
- Constant electricity supply, especially during the day.
- Efficient transportation systems to timely deliver greenhouse produce to local markets.
- The nearby area should have sufficient labourers to choose from. A one-acre greenhouse typically needs four workers to cultivate flowers.
- Planting of windbreaks, such as poplar, silver oak, casuarina, etc., on the western side of the greenhouse, about 20 metres away, because west winds are the strongest.

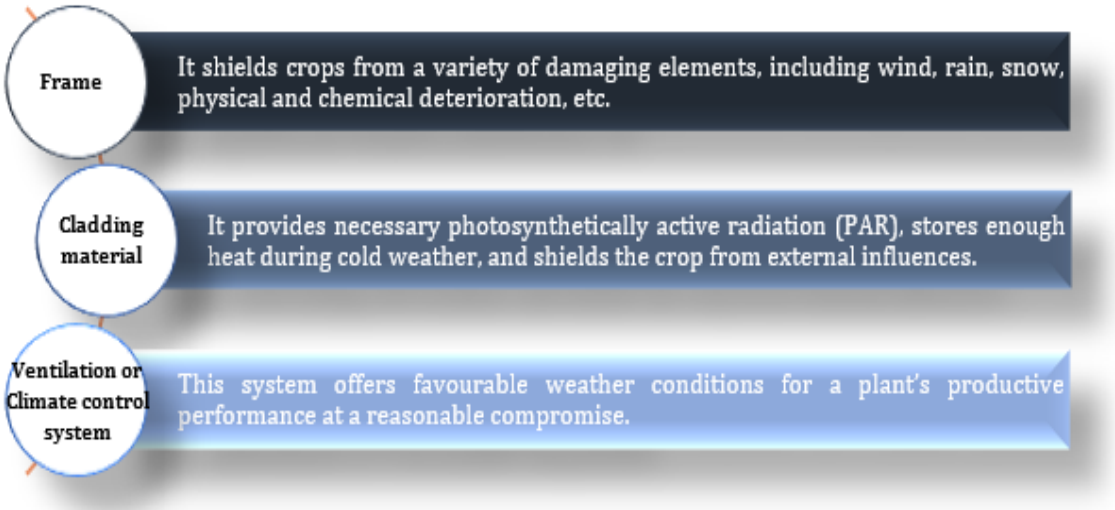

Fig. 1- Components of Protected Cultivation Structure

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published **29.05.2023**

Types of Protected Cultivation Practices

1. Greenhouse

Greenhouse have emerged as vital structure in global agriculture as shown in Fig. 2. Crops are cultivated in greenhouses, which are basically framed structures covered in UV-stabilized plastic sheets. The atmosphere inside a greenhouse is either partially or completely regulated.

Type of Structures:

- Naturally Ventilated– Tubular, Wooden and Bamboo structures.
- Fan & Pad System– This system draws air through evaporative cooling pads using exhaust fans.

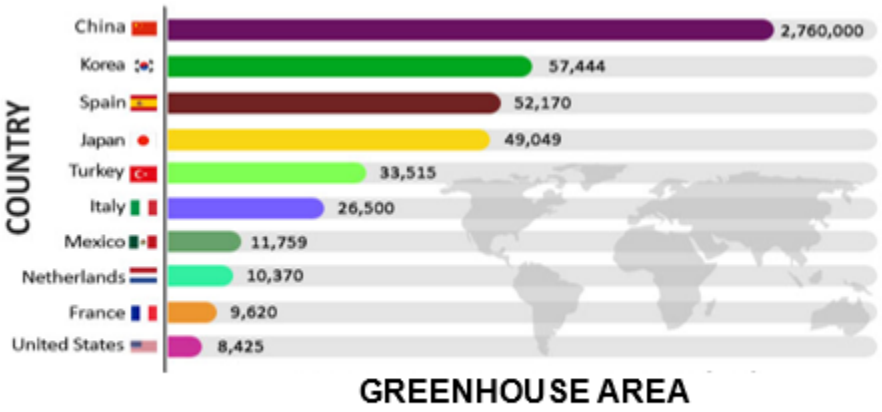

Fig. 2- Status of Greenhouse worldwide (Kacira, 2011)

2. Shade net house

- One of the most important technologies for fostering the growth of healthy grafts/seedlings and hardening of a variety of horticultural crops, regardless of climatic circumstances, is the usage of shade net houses.
- Perforated plastic shade nets are used to block out the sun's rays and reduce the scorching or wilting of leaves brought on by rising temperatures.
- The main goal of a shade net is to somewhat lower temperature and radiation during the hot summer months (May to September).
- There are various shading strengths of shade nets, from 25-75%.

3. Insect-proof net house

- It can be created as a temporary or permanent structure and is affordable.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published **29.05.2023**

- The structure is covered in a 40–50 mesh UV–stabilized insect– and rust–resistant nylon or metal net.
- The main goal is to create a barrier to prevent hazardous insect-pest and disease vectors from entering.
- Pesticide consumption is reduced in fresh vegetable cultivation while using insect-proof net houses. Tomato, chilli, sweet pepper, and other crops can be raised using this technique, but in order to grow them in insect proof net houses, it is necessary to nurture virus-free, healthy seedlings of the crop either in a greenhouse or by enclosing the nursery beds with insect proof net.

4. Walk-in Tunnels

All types of crops, including flowers and vegetables, are ideal for the walk-in tunnels, which are protected with UV film. These can endure winds of up to 120 km/h and trellising weights of up to 25 kg/m2. An 8- or 10-metre-wide structure gable layout is possible. The height is 4.10 metres (2" pipe) for 8 metres and 4.50 metres (3" pipe) for 10 metres. There is an option for side walls of tunnels to have vertical curtains (2 metres long) as shown in Fig. 3.

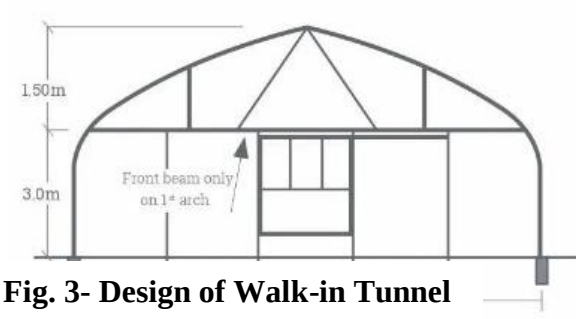

Fig. 3- Design of Walk-in Tunnel

5. Plastic Tunnels

These are miniature structures providing a greenhouse-like effect (Fig. 4). Facilitates the entrapment of carbon dioxide thereby enhancing the photosynthetic activity. It shields plants from abrasive weather conditions including rain, wind, hail, snow, and so forth. These serve primarily for raising nursery.

Fig. 4- Plastic Tunnels

6. Plastic Mulching: In-situ Moisture Conservation

Plastic mulching involves wrapping plastic film around the soil surrounding the plant to conserve the soil moisture that inhibits weed growth and regulate soil temperature. Mulching also accelerates the active root zone's uptake of micronutrients from the soil. Mulches can be made of various coloured plastic sheets, such as black, silver-black, red, yellow, while-black, etc.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 29.05.2023

Limitations of Protected Cultivation

- High capital costs for the initial infrastructure.
- Lack of trained human power and failure to find their local substitutes.
- Lack of technical understanding of growing crops under protected structures.
- Each and every operation is labour-intensive and require constant effort.
- Needs constant inspection and monitoring.
- Some pests and soil-borne pathogens can be challenging to control.
- The biggest obstacles are repair and upkeep.
- Requires assured marketing, because a significant investment of time, effort, and money is anticipated.

Conclusion

Harnessing innovations through protected cultivation stands of significant leap forward in the Indian agriculture and offers to address considerable variations in the meteorological conditions across the diverse topography allow numerous cropping patterns throughout the country. India also experiences climatic extremes like floods, droughts and other climatic anomalies that routinely result in agricultural losses or damages resulting in economic losses to the farmers. Over the past ten years, the demand for high-quality agricultural products has grown concurrently. This offers Indian farmers greater opportunities to employ protected cultivation techniques according to their region and the suitability of the crops and also can pave a way to empower farmers to embrace technological innovations, incorporate precision resources and climate control system with automation.

References

Kacira, M. (2011). Greenhouse Production in US: Status, Challenges, and Opportunities. Presented at CIGR 2011 conference on Sustainable Bioproduction WEF 2011, September 19-23, 2011 at Tower Hall Funabori, Tokyo, Japan.

Nair, R. and Barche, S. (2014). Protected Cultivation of Vegetables – Present Status and Future Prospects in India. *Indian Journal of Applied Research*. 4(6): 245-247.

Punera, B., Pal, S., Jha, G.K. and Kumar, P. (2017). Economics and Institutional Aspects of Protected Cultivation of Carnation in Himachal Pradesh. *Agricultural Economics Research Review*. 30(1): 73-80.

Sabir, N. and Singh, B. (2013). Protected cultivation of vegetables in global arena: A review. *Indian Journal of Agricultural Sciences*. 83(2): 123-35.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

***Published* 29.05.2023**