



Comprehensive Review On Global Scenario Of Protected Cultivation In Horticulture

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Abstract: Horticultural crops cultivated inside protection are becoming more essential in present agriculture, with multiple benefits such as greater production, improved quality, and resistance against insects and unfavorable weather. The review starts with a variety of protected developing structures, such as polyhouse, high tunnels, and greenhouses. In order to fulfill the goals of protected crops, the most efficient technique is the greenhouse. Indian agriculture now considers polyhouse-based cultivation to be essential. One of the most extensive farming practices is greenhouse horticulture, which provides advantages in terms of controlled climatic factors, better utilization of resources, and the application of modern technologies. Protected cultivation, which involves applying robotics, incorporating precision cultivation techniques, and using smart farming technologies. These advancements could further optimize utilization of resources, increase automation, and improve crop evaluation and management, which will ultimately result in greater yield and quality improvements in the production of crops used in horticulture.

Index Terms – Protected cultivation, Global and Indian scenario

I. INTRODUCTION

Definition of protected cultivation

Protected cultivation is the cultivation of crops under controlled conditions. It is an approach to produce mainly horticultural crops, qualitatively and quantitatively. It is highly conservative of water and land and also protective of the environment and highly productive (N. Sabir and B. Singh, 2013). It developed after World War 2. It appeared first in Northern Europe in the early decades of the last century (S. Hassan and S. Mehraj and A. Jan et.al, 2017). It refers to the practice of growing crops in an enclosed environment like greenhouses, playhouses, and high tunnels. The main purpose of protected cultivation is to make a controlled microclimate that protects the crop from pests' diseases and adverse weather conditions (S. Jain and Deepak S. Kore et.al, 2023). Various technologies involve the cultivation of horticultural crops where factors like temperature, humidity, light, soil, water, and fertilizer are manipulated to maximize produce as well as a regular supply during off-season (Naved Sabir and Balraj Singh, 2013). There are different types of protected cultivation such as greenhouses, glass houses, shade houses, high tunnels, net houses, and playhouses (Deepak Kumar and Satendra Kumar, 2020). Protected cultivation is broadly utilized in the production of many crops like fruits, flowers, vegetables, and herbs. It involves crop cultivation with improved quality beyond their regular growing season, by using a structure like a greenhouse. These are the structures covered with transparent materials for example polythene or glass which act as radiation barriers (S. Jain and Deepak S. Kore, 2023). Insect-proof greenhouses can be employed for the cultivation of crops such as leafy vegetables and other vegetables free from viruses, mostly during the rainy season. This inexpensive structure is beneficial for cultivating natural or organic vegetables (Deepak Kumar and

Satendra Kumar,2020). The world scenario indicates that the area under protected cultivation is approximately 623,305 hectares (Naved Sabir and Balraj Singh, 2013).

Sl.no	countries	Greenhousearea (Ha)
1	China	2,760,000
2	Netherland	10370
3	India	5730
4	Italy	26,500
5	South Korea	57,444
6	Japan	49,049
7	United State	8425

1.1 Importance of protected cultivation

Nowadays climate change is a major issue that can't be ignored. The main fundamental causes are man-made or artificial or human generated like, forest deterioration for commercial use, urban over crowding (R.K Pattanaik and S. Mohanty,2021).

- From cold, wind, storm, rain, and frost,cropsare protected.
- Plant growth, germination, and quicker maturation of crops are due to the controlled environmental conditions.
- Efficient employment of input
- There be increased entrepreneurship for educated young people.
- Participation in labor collection would be decreased.
- Increased the level of productivity
- Off season farming
- Improved plant preservation

1.2 Factors affecting the protected cultivation in horticulture (V. K. Singh and S. Rajan, 2015)

- Climate and soil
- Cost
- Knowledge and skill
- Market demand and profitability

II. VARIETIES OF PROTECTED STRUCTURE

2.1 Greenhouse

Horticulture is characterized by numerous approaches. Among these, a greenhouse is one of the most vigorous agricultural systems, which concentrates on the production ofdesirable products. Greenhouse has a progressive field of agriculture in the use of new technologies. This has elevated due to the demand for more effective use of resources and more sustainable farming practices (A. Koukounaras, 2021).Greenhouses are the more refined type of protected structure made of glass or polycarbonate and can be furnished with a variety of environmental controls(Dalai.s.et al, 2020). A greenhouse is different from others mainly the nature of the structural component used for construction. It is estimated that the area under greenhouse vegetable production in 2019 was 496,800h (HortDaily,2019). Nearly 80 percent of the area under greenhouses is located in eight countries i.e. China, Spain, South Korea, Japan, Turkey, Italy, Morocco, and France (krishna nameli,2022)



2.1.1 Types of green house

Lean to type greenhouse

The concept involves placing a greenhouse on a building that already exists to optimize sunlight while decreasing the demand for roof support. The building's roof is being widened using a suitable greenhouse covering material, and the area is properly enclosed (D. Salathia and M. Ul Nisa et al. 2018).



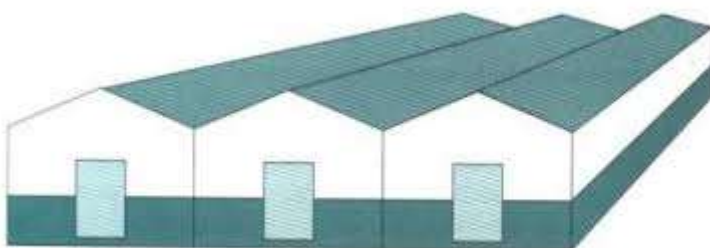
Even span type

Greenhouses of this kind can be found all over India. Greenhouses of small sizes are ideal for use on flat surfaces. This type of greenhouses contains two roof levels which are evenly pitched and broad. This may consist of either one or several span types. Single-span kinds normally have a height of 4-9 m having an overall length of about 24m. Its height varies from around 2.5 to 4m (D. Salathia and Nisa et al. 2018).



Uneven span type

This greenhouse has been constructed on hillsides. The greenhouse's roofs are identical in size, helping owners to take benefit of the hilly slopes. They are appropriate for rocky areas. These are not automation-ready



Polyhouse

A polyhouse is an example of a greenhouse where sunlight is allowed to pass as it is covered in flexible transparent plastic films (A.Kaushal and A.Digra, 2021)

In India, naturally ventilated cultivation houses are the most common greenhouse structure, which consist of steel tube structures covered by pest-tolerant screening and ultraviolet-resistant polythene sheets (Hong et al, 2017; Nayak et al, 2018). Moisture and wind from strong wind are the main factors that could damage the structure and covering of poly houses; thus all components should be created sufficiently under pressure for their safety. The parameters used for design have to be determined by related requirements, that give direction to evaluate different loads for an appropriate protection as well as to avoid severe (Elsner et al., 2000; Castellano, 2007)



High Tunnel

High tunnels are not equivalent to greenhouses, although the fact that greenhouse term is the basis for the way they work. The term high tunnel sometimes known as a hoop house, has been used to designate structure getting a single or double layer of film made of polythene wrapped over rings of steel or polyvinyl chloride. High tunnels (HTs), as greenhouses, depend on natural air circulation rather than artificial climate control or heating, reducing expenses on both setup and maintenance. Because long-term heating methods are present a few gardeners give supplemental heat through the use of a non-vented gas heater for shielding crops from freezing temperatures at the beginning of spring and the end of autumn. High tunnels have been widely used for a long time worldwide, whereas in the United States, their adoption is quite new (R.R Janke and Altamimi et. al, 2017).



III. HISTORICAL OVERVIEW

Origin of protected cultivation

The concept of cultivating plants in an artificially regulated setting is known since the Roman period. Farmers used manufactured methods of cultivating fruits and vegetables for regular consumption. In the middle of the 17th century, the concept of protected structure was built in both the Netherlands and England. In 1718, the initial greenhouse with glass on every side was constructed in Chicago. In 1815, America developed its first industrial greenhouse. Polyethylene's first use as a greenhouse covering material was in 1948. In 1985, the Indian Agricultural Research Institute (IARI) established and constructed a greenhouse

in Leh, in 1990 the Indo-Israeli cooperation prompted the creation of a contemporary greenhouse (Deshmukh and Akola, 2023)

IV. GLOBAL AND INDIAN SCENARIO

A report released by, China comprises 43% of global area under controlled environment agricultural crops in 2023, with an anticipated sum of 623,302 hectares. Some significant producers are Turkey, Spain, Italy, and Japan. In India, approximately 11,000 acres are used for protected cultivation of crops related to horticulture. Protected cultivation of horticultural crops produces higher profits and superior production than with unprotected area. Protected agriculture provides for approximately 150 million tons of globally horticulture production of crops. Protected horticulture produces various vegetables, fruits and flowers. The FAO of China predicts that global region covered by controlled environment will reach 3 million hectares in 2019. China is the leader in controlled environment agriculture, having more than four million hectares in production. Protected farming techniques use multiple methods, such as naturally ventilated polyhouses, drip irrigation, and mulching. On-site polytunnel have been shown profitable in the Northern plains of India for growing crops that include tomatoes, capsicum, and cucurbits, in addition to developing nurseries in the off-season (S. Jain and D S. Kore, 2023).

V. TECHNOLOGICAL ADVANCEMENT IN PROTECTED CULTIVATION

The advancement of technology for controlled environment farming, such as hydroponics, controlled climate management, and vertical gardening, have been widely developed in advanced countries(S. Jain and Deepak S. Kore, 2023).

5.1 Automation technology and Robotics system

Greenhouse production is a high labor sector that primarily demands for human labor. The requirement for technology, automation techniques and robotics system is due to the increased expense of labor, which is a severe issue in industrial and advanced countries compared to undeveloped ones.

A profitable harvest is typically the most significant and expensive during two crucial moments during the period: the beginning of cultivation and the moment of harvest. Crop preservation in greenhouses can be extremely laborious. Since multiple creative methods, like automated planting, transplanting, cutting, grafting, and spacing, were introduced at this point for the initial phase of culture, crop upkeep, and harvesting have not yet been fully automated, apart from certain improvements. The size, form, along other characteristics of the facility, are appropriately defined as well as uniform in the first stage of the production phase; so basic automation systems based on mechanical methods can function effectively using only a limited number of instruments and machineability. The position, as well as size, shape, and coloration of harvests, vary significantly, making crop preservation and harvesting much more difficult to control. Rather, high-tech automation, robotics, or mechatronic systems will be required. Mechanization is driven by several variables in extra labor expenses, specific cultivation and a shortage of skilled labor, increasing diseases from extremes of humidity and temperature. All these problems have greatly affect greenhouse farming. These include commercial machines for cutting, and harvesting, Automatically Guided Vehicles that can regulate people's work and progress. The achievement of such equipment will be dependent not just on advancements in mechanization, automation technique, and robotics system, but also on a fusion of initiatives in other related fields including breeding plants, the structure of greenhouse, protection, and staff education and qualification (N.S Gruda and J. Tanny, 2015)

5.2 Variety Selection:

There are many of components to think about while selecting plants for greenhouse farming. While selecting a crop, we must consider market conditions, the crop's growth structure, and its special ability for higher production in contrast to open-field production performed outside of the growing period. The presence of greenhouses and climate control systems nowadays. The choice of variety of crop is influenced by variables like genetic prospective, consumer desire, and feasibility (Sanmukh, S.,et al., 2019).

5.3 Drip irrigation

For growing any kind of horticulture product in a field or greenhouse, drip irrigation is an extremely profitable and effective approach (A. K Srivastava, B. Singh et al., 2019). Protection of crops needs a successful system of irrigation, especially micro irrigation. Because greenhouses prohibit rainwater from reaching crops, artificial irrigation systems must be used for the purpose of allowing plants to remain alive and grow. There are several methods of irrigation, and each one has benefits as well as drawbacks. The size and type of plants growing inside the protective structure have an important effect on selecting an appropriate irrigation method. The most effective irrigation is frequently the outcome of a mix of techniques. (K Vishunavat, 2013).



5.4 Micro irrigation

Micro irrigation systems perform adequately at low pressure and have high levels of efficiency. Filters of a variety are provided for pollutants; however, dirt, algae, and chemical-based fertilizers may block them (Vishnukant k, 2013).



5.5 Precision technology

The concepts of artificial intelligence, drones, and sensors are several examples of the precision technology in agriculture being used to increase crop output while reducing the cost of inputs.

Area	Crop	Protected cultivation	Reference
China	Cucumber, tomato, eggplant, watermelon	Energy saving, solar, lean to green house	J Janick, 2003
Nepal	Gerbera, black pepper,	High tunnel	Lamichhane.P., Adhikari, J., & Poudel, A. (2023).
Japan	Lettuces, lactuca sativa, garland chrysanthemum	Hydroponics	Kang.y et al., 2013

Conclusion

With protected cultivation, crops are able to grow in a regulated environment where factors like temperature, rainfall, and light may be modified based on the crop's requirement. The total production increases and healthier plants are promoted in this environment. Safe farming techniques include a range of structures and techniques, including as high tunnels, net houses, drip irrigation, micro irrigation, variety selection, and precise technologies. By protecting crops from adverse conditions, extending the growing season, and allowing off-season crop production, all these techniques are used to create a perfect growing environment. Adopting this advancement provides advantages including higher soil moisture retention and weed control.

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