RESEARCH PAPER | Horticulture | Volume : 4 | Issue : 6 | June 2014 | ISSN - 2249-555X

Protected Cultivation of Vegetables – Present Status and Future Prospects in India

KEYWORDS: Protected Cultivation, vegetable cultivation, types of green houses, advantage and limitations

Dr. Reena Nair
Technical Assistant, AICRP on Arid Zone Fruits Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Nagar, Adhartal, Jabalpur- 482 004 M. P. INDIA

Dr. Swati Barche
Associate Professor, Horticulture Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Nagar, Adhartal, Jabalpur- 482 004 M. P. INDIA

ABSTRACT *Horticulture today forms an integral part of food, nutritional and economic security.Adoption of horticulture, both by small and marginal farmers has brought prosperity in many regions of the country as India is endowed with a wide variety of agro-climatic conditions & enjoys an enviable position in the horticulture map of the world.Inspite of its great importance, it facing a lot of constraints like photostress, moisture stress, temperature stress, weed growt, deficiencies in soil nutrients, excessive wind velocities and atmospheric carbon-dioxide.These constraints can be alleviated by adopting a unique, specialized hi-technology known as protected cultivation.the intent is to grow crops where the extreme conditions are existed and plant could not survive by modifying the natural environment. Protected cultivation of vegetable offers distinct advantage of quality, productivity and favorable market price to the growers. It increases their income in off- season as compared to normals season.off season cultivation is one of the most profitable technology under Northern Plains of India. Virus free cultivation of Tomato, Chilli, Sweet pepper, ccucumber and other vegetables mainly during rainy season.*

Introduction

Vegetables are recognized as health food globally and play important role in overcoming micronutrient deficiencies and providing opportunities of higher farm income. The worldwide production of vegetables has tremendously gone up during the last two decades and the value of global trade in vegetables now exceeds that of cereals. The worldwide production of vegetables has doubled over the past quarter century and the value of global trade in vegetables now exceeds that of cereals. Vegetables are generally sensitive to environmental extremes, and thus high temperatures and limited soil moisture are the major causes of low yields and will be further magnified by climate change. India is the second largest producer of vegetables in the world, next to China. India's share of the world vegetable market is around 14%. It produces 133.5 millions tonnes of vegetables from an area of 7.9 million hectares (NHB, 2010). According to statistics release by Ministry of Agriculture, there has been 13.5% increase in area and 13.4% increase in vegetable output during the period 1996 to 2010. In spite of all these achievements, per capita consumption of vegetables in India is very low against WHO standards (180 g/day/capita against 300 g/day capita recommended by FAO). There are different ways and means to achieve this target, e.g., bringing additional area under vegetable crops using hybrid seeds, use of improved agro-techniques. Another potential approach is perfection and promotion of protected cultivation of vegetables. In natural season local vegetables flood the markets substantially bringing down the prices. In the absence of storage infrastructure and vegetable processing industry in the country, off-season vegetables farming is the only viable option that can add value to the farmer produce. Vegetables can be cultivated in off-season, with the induction of an artificial technique like greenhouse technology, in which temperature and moisture is controlled for specific growth of vegetables.

Protected Cultivation

Protected cultivation practices can be defined as a cropping technique wherein the micro environment surrounding the plant body is controlled partially/ fully as per plant need during their period of growth to maximize the yield and resource saving. Greenhouse is the most practical method of achieving the objectives of protected agriculture, where natural environment is modified by the use of sound engineering principles to achieve optimum plant growth and yield (more produce per unit area) with increased input use efficiency.

The green house is generally covered by transparent or translucent material such as glass or plastic. The green house covered with simple plastic sheet is termed as poly house. The green house generally reflects back about 43% of the net solar radiation incident upon it allowing the transmittance of the "photosynthetically active solar radiation" in the range of 400-700 Nm wave length. The sunlight admitted to the protected environment is absorbed by the crops, floor, and other objects. These objects in turn emit long wave thermal radiation in the infra red region for which the glazing material has lower transparency. As a result the solar energy remains trapped in the protected environment, thus raising its temperature. This phenomenon is called the "Green house Effect".

Greenhouse is the most practical method of accomplishing the objectives of protected cultivation (Nagarajan et al., 2002). Tomato, Capsicum and cucumber are the most extensively grown vegetables under green houses and give higher returns (Chandra et al., 2000). Growing of cucumber using cost effective plastic greenhouses provides an alternative for raising crop in the period of scarcity in Himachal Pradesh. This also ensures to meet year round supply of fresh produce with more efficient resource utilization. (Sharma et al., 2009). New features added to these structures have cut down the requirement of water and energy in such cultivation through novel means like micro irrigation-cum-fertilization (fertigation) and rainwater harvesting.

Present status vis-a-vis global and National scenarios

The idea of growing plants in environmentally controlled areas has existed since Roman times. The Roman Emperor Tiberius (42 to 37 B.C.) daily ate cucumber grown through artificial methods (similar to the greenhouse system). The gardeners planted cucumbers in carts that were wheeled into the sunlight by day and brought indoors by night to protect them from the elements. This was an innovative form of the

Volume : 4 | Issue : 6 | June 2014 | ISSN - 2249-555X

greenhouse. In the 16th century, European explorers brought back exotic plants acquired in the course of their travels. Many were tropical plants that could not survive the cold European climates. The result was the creation of greenhouses that would progress from the Italian "botanical gardens" to wooden structures to the more stable cast iron frames, and eventually to glasshouses. Later, with the advent of plastics during the World War II a new phase in the greenhouse technology emerged. At present nearly 90 per cent of the new greenhouses are being constructed by utilizing ultra violet (UV) stabilized polythene sheets as the glazing material.

There are more than 55 countries now in the world where cultivation of crops is undertaken on a commercial scale under cover and it is continuously growing at a fast rate internationally. China is the largest users of greenhouses. The development of greenhouse technology in China has been faster than in any other country in the world. With a modest beginning in late seventies, the area under greenhouses in China has increased tremendously. The world scenario of greenhouse production is given in Table-1.

Table-1 Worldwide Total Area in Major Greenhouse Production Countries

Country	Greenhouse 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)

India's first exposure to truly hi-tech protected farming of vegetables and other high-value horticultural produce came through the Indo-Israel project on greenhouse cultivation, initiated at the New Delhi-based Indian Agricultural Research Institute (IARI) in 1998, shortly after the establishment of diplomatic ties with that country. However, the Israeli experts left India in 2003 at the end of this five-year project, IARI continued to maintain the facility, calling it the Centre for Protected Cultivation Technology (CPCT). It has, in the past 10 years, managed to refine and upscale the system to reduce costs, besides designing greenhouse structures to suit local conditions. The area under greenhouse cultivation, reported by the end of 20th century was about 110 ha in India and world over 275,000 hectare (Mishra, et al 2010). During last decade this area must have increased by 10 per cent if not more. The states that have consistently expanded the area under protected cultivation for the period of 2007-2012 are Andhra Pradesh, Gujarat, Maharashtra, Haryana, Punjab, Tamil Nadu and West Bengal. Maharashtra and Gujarat had a cumulative area of 5,730.23 hectares and 4,720.72 hectares respectively under the protected cultivation till 2012.

In Europe, Spain is leading in protected agriculture with 51,000 ha mostly under low cost poly houses. In Asia, China has the largest area under protected cultivation, 2.5 million ha under poly house/greenhouse. Protected vegetable production is important component of protected agriculture. Protected vegetable production is practiced throughout the world irrespective of altitude of the place since several hundred years.

Advantages of Protected Vegetable Cultivation

Protected vegetable production can reduce the amount of water and chemicals used in production of high value vegetables compared to open field conditions. The comparative advantages are:

1. Year round production of vegetables.
2. Adverse climate for production of vegetables can be overcome by different systems of protected production.
3. Multiple cropping on the same piece of land is possible.
4. Off season production of vegetables to get better return to growers.
5. Production of high quality and healthy seedlings of vegetables for transplanting in open field supporting early crop, strong and resistant crop stands.
6. Use of protected vegetable cultivation can increase production as well as productivity per unit of land, water, energy and labour. It supports the production of high quality and clean products.
7. It makes cultivation of vegetables possible in areas where it is not possible in open conditions such as high altitudes deserts.
8. It makes vertical cultivation of vegetables possible using technologies like hydroponics, aeroponics etc and use of vertical beds for production.
9. Disease free seed production of costly vegetables becomes easy under protected structures.
10. The potential of polyhouse production technology to meet the demand of producing good nutrition and healthy foods and quality vegetables free from pesticides can be fully exploited.
11. Controlled environmental conditions are used for early raising of nurseries, off-season production of vegetables, there seed production and protecting the valuable germplasm
12. Vegetable crops can be grown under adverse weather conditions round the year and off-season.
13. Management and control of insect-pests, diseases and weeds is easier.
14. Maintenance of stock plants, cultivating grafted plantlets and micro propagated plant-

Limitations

1. Manual or hand pollination in cross pollinated vegetables like cucurbits or development of their parthenocarpic hybrids/varieties.
2. Expensive, short life and non-availability of cladding materials.
3. Lack of appropriate tools and machinery.
4. Structure cost initially looks unaffordable. Farmers with zero risk affordability do not come forward to adopt it.

Components of Green house

Protected cultivation has two major components of technology. One is the infrastructure involving frames, cladding materials, irrigation system, tools, implements, other engineering inputs and another is crop production technology.

Infrastructural inputs ensure optimal light, air temperature, water and plant growth requirements. This optimal aspect of climatic parameters involves simple to most advanced engineering inputs such as automation, etc. to regulate several parameters such as ventilation which is one of the most important components in a successful greenhouse production. A major problem with conventional designs of greenhouses is the concentration of heat within the covered structures, which needs to be either expelled or neutralised through energy-intensive cooling facilities. This problem has been overcome by designing naturally ventilated greenhouses where the temperature can be maintained at the desirable level without consuming any energy. Importance of cladding materials in protected cultivation can hardly be overemphasized. Their quality and cost are important besides certification. Micro irrigation and fertigation involves a lot of science and technology, demanding research for continuous improvement. It is the engineering aspect of the protected structure which provides plants optimal conditions to grow normally.

Another aspect of protected cultivation is crop production technology which involves development of high-yielding va-

Volume : 4 | Issue : 6 | June 2014 | ISSN - 2249-555X

rieties and hybrids of crops suitable for protected cultivation.

Common types of greenhouses being used in India

1. Plastic greenhouses with natural ventilation
2. Greenhouses with fan and pad cooling system
3. Solar greenhouses (Leh design)
4. Walk-in tunnels (Dry temperate areas in HP)
5. Plastic low tunnels
6. Net houses and Anti-insect cages
7. Under ground trenches (Leh and Ladakh region)

Causes for Green House Failure / Damage

1. The profile used in the GH frame, trusses and other member too light which deformed by
2. strong Winds.
3. Cladding material some time appeared to be stronger than structure
4. Poly film tearing because of rough and sharp edge of the frame
5. The foundation not sufficiently secured against uplift forces
6. Damage of polyfilm often started from the ventilation openings.

Government Assistance

For adoption of Greenhouse Technology by farmers, Government of India has been providing subsidy @ 50% of the total cost indicated below in Table-2 with a maximum ceiling upto 4000 m^2 per beneficiary under National Horticulture Mission (NHM) and Horticulture Mission for North East and Himalayan States (HMNEH)

Table-2 Subsidy given by Government to farmers

Items	Pattern of Assistance (Rs/m^2) upto 4000 m^2 per beneficiary		
	Tubular structure	Wooden Structure	Bamboo Structure
Greenhouse with Fan and Pad system	1465	-	-
Naturally ventilated greenhouse	935	515	375

Source: Iyengar et al. (2011)

Conclusion

The greenhouse technology is still in its preliminary stage in India and concerted efforts are required from all concerned agencies to bring it at par with the global standards. Economically viable and technologically feasible greenhouse technology suitable for the Indian agro-climatic and geographical conditions is needed at the earliest. Globalization coupled with economic liberalization will help in achieving the desired results. Efforts should be made to synthesize energy conservation principle along with environmental safety on a broader perspective. The future need for improving this technology are:

1. Standardizing proper design of construction of polyhouses including cost effective and indigenously available cladding and glazing material.
2. Computerized Control System maximize returns it includes time base/volume base/sensor based irrigation system, opening and closing of ventilators and side wall roll up curtains, CO_2 Generator, Climate Control, Temperature, Humidity, Heat Radiation, Control of EC, pH, ppm level of elements in irrigation water etc. as required to the plant.
3. Developing cost effective agro-techniques for growing of different vegetable crops in the different types of polyhouses and lowering energy costs of the green house environment management.
4. Major research activities on growing of vegetables under protected covers should be launched by ICAR and SAU's.
5. 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 F_1 hybrid varieties so that seed are made available to the growers in time and at cheaper rates.
6. Government initiatives/efforts in popularizing the greenhouse technology among the farming community of the country are to be strengthened.

REFERENCE Chandra P., P.S. Sirohi, T.K. Behera and A.K.Singh. 2000. Cultivating vegetables in polyhouse. Indian Horticulture. 45: 17-25. | Iyengar, K.S., Gahrotra, A., Mishra, A., Kaushal, K.K. and Dutt, M. (2011). Greenhouse-A Reference Manual. NCPAH, New Delhi. pp 23. | 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. | Mishra, G. P., Singh, N. and Kumar,H. and Singh, S. B. 2010. Protected Cultivation for Food and Nutritional Security at Ladakh Defence Science Journal, 61(2), March 2010, pp. 219-225 | Nagarajan M., S.Senthilvel and D.Planysamy. 2002. Material substitution in Green house construction. Kisan World. 11:57-58. | Sirohi P.S. and T.K. Bahera. 2000. Protected cultivation and seed production in vegetables. Indian Horticulture.45: 23-25. |