

Sustainable agriculture

through protected cultivation

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The practice of protected cultivation is still developing in India. Input application and protection technology improvement techniques are being developed. For off-season vegetable cultivation, low-cost protected technologies such as plastic low tunnels or walk-in tunnels can be employed to generate excellent returns. Similar to this, virus-free crop production can be achieved by using insect-proof net buildings on a big scale. This will reduce the usage of pesticides in vegetable agriculture. More eco-friendly plastics are being produced for making the processes more efficient. Therefore, protected cultivation could bring prosperity to horticulture crop growers of India and ensure nutritional security for everyone.

Keywords: Horticulture, Mulching, Protected cultivation

INDIA'S agriculture often finds itself up against a variety of obstacles caused by dynamic factors like climate change, degraded soil, population pressure, fragmented land use, limited water supplies, marketing and entrepreneurship, etc. One of India's most important agricultural sectors is horticulture, which is quickly taking over. India produces the most fruit crops and is the second-largest producer of vegetables, with a 146 mt output from an 8.4 mh area, after China. Although the area dedicated to horticulture has grown over the past 20 years, primarily at the expense of other crops, there is little chance of an increase in the cultivable area. Despite the fact that protected cultivation only covers around 60,000 ha, it is quickly becoming one of the most promising fields in terms of enhanced productivity, quality, income, entrepreneurship, etc. However, the advancement of protected technologies area coverage in terms of per cent coverage is very encouraging. This article discusses the full spectrum of protected cultivation technology,

its potential, suitable regions and crops, overcoming the difficulties of biotic and abiotic stresses, market linkages and overall empowerment of farmers in terms of knowledge, input availability and use-efficiency, plant protection, post-harvest loss management, and market linkages, among other things. Protected cultivation in horticulture, if properly implemented, offers a great deal of promise to farmers who use the technology with sustainable solutions for increased productivity, improved livelihoods, and nutritional security, especially as cooperative clusters of high-tech farming. Protected cultivation under greenhouses, polyhouses, net-houses, tunnels, mulches, etc., all of which include intelligent and thorough use of plastics in various forms, based on requirements, suitability of regions, climates, crops and technologies infrastructure or paraphernalia e.g. UV stabilized polythene sheets, insect-proof nets, shade-nets, mulches, drip irrigation pipes, filters, tanks, plastic-lined water harvesting, etc.

Protected cultivation fulfilling agricultural expectations

Agriculture often places significant pressure on natural resources and the environment. Sustainable agricultural practices are intended to protect the environment, expand the earth's natural resource base and maintain, and improve soil fertility. Demand for agricultural commodities is rising rapidly as the world's population grows. Agriculture's deep connections to the world economy, human societies and biodiversity make it one of the most important frontiers for conservation around the globe. It is noteworthy that protected cultivation appears to be the only area of agriculture that can address the majority of its inherent constraints into an ideal system that could address them as modules of systematic and sustainable farming, including healthy planting material, quality seed production, conservation and optimization, and input use efficiency of water and other resources, precision farming, good agricultural practices (GAP), integrated pest management (IPM),

integrated nutrient management (INM), grafting and soilless cultivation. Protected cultivation technology is, thus, the future of horticulture. The potential of addressing soil erosion, recycling abilities, as well as amelioration of soil and water pollution are additional boons to overall ecosystem besides the economy of agriculture. Above all the advantages, protected cultivation is very amenable to women workforce.

Variety of technologies that fall under the category of protected cultivation are given as:

Poly-house

A poly-house is permanent structure, covered with a transparent or translucent material. Materials used to construct a poly-house frame may be wood, bamboo and steel or even aluminum. Coverings material is generally a plastic film. Two types of poly-houses are designed in Indian condition, one is called naturally ventilated poly-house and the other is force ventilated (fan-pad) poly-house. Naturally ventilated poly-houses are used mainly in temperate and moderate climate conditions, while force ventilated (fan-pad) poly-houses are suitable for tropical, sub-tropical and arid zone farming systems. Poly-house is made by GI pipe and covered by ultra-violet (UV) stabilized plastic sheet with a service life of 3–4 years. These sheets are generally available in 7 and 9 meter widths with 200 micron thickness. Poly-house technology is the most intensive form of commercial cultivation. This structure provides favourable growing condition to crop plants and protect them from extreme

fluctuations in weather, especially temperature, rainfall and wind, and also minimize evaporation losses besides protection from birds, animals and insect pests, and diseases to quite an extent. The poly-house structures provide 4–5 time higher yields with export quality produce; high water and fertilizer use efficiency and round the year production facility in any part of the country.

Major vegetable crops for poly-house are indeterminate tomato, cherry tomato, cucumber, capsicum, bitter gourd, musk melon and summer squash. Among flower crops; rose, gerbera, lily, tulip, anthurium, carnations, orchids, chrysanthemum and their nursery can be grown in poly-house. Among fruit crops group; strawberry, papaya and all fruit-nursery propagation or hardening are used for economically profitable horticulture-based farming systems.

Net built structures

Generally two types of net-built structures are used, viz. shade-net and insect-proof net houses often termed synonymously, but indeed, a shade-net is primarily a covering of UV stabilized coloured plastic net where main objective is to provide protection to the horticultural nurseries and plants from harsh sunlight and hot winds during summer seasons. On the other-hand, insect proof net houses are built for the primary objective of screening out the entry of insects or other pests by the physical barrier of nets of various mesh sizes depending upon crop and season.

Shade net houses: Shade nets generally use two colour nets

(green and black) in horticulture-based farming systems. Both colour shade nets are available in 30, 50, 75 and 90% (percentage of reduction in sunlight) capacity of shading protection. Shade nets also cut down the sunlight, in turn minimizing evapotranspiration losses of moisture in general as well as reduced transpiration from plants. The total effect creates an altered relative humidity and temperature regime of microclimate favouring the plant growth. That is why these structures are especially useful for dry land and arid areas with water scarcity by increasing water use efficiency when used in combination with drip irrigation. Suitable crops identified for shade net houses from economic viability include horticulture nurseries, leafy vegetables, summer tomato and capsicum. Ornamental crops like lily, tulip, anthurium and orchids can also be grown economically depending upon suitability of different agro-climatic zones.

Insect-proof net houses: These structures make use of insect proof screens of different intensities of perforations, ranging from 25 mesh to 60 mesh. IPP nets of 40 or higher mesh are effective means to control entry of most flying insects and save crop from diseases. These structures permit early planting of tomatoes, cucumber, bitter gourd, musk melon, summer squash, brinjal and chilli etc. without the risk of vectors. Insect proof net house enhances 25–35% more yield as compared to traditional methods during peak summer season. These structures can be used successfully for seed production in rainfed areas. Crops suitable for these structures include tomato, cherry tomato, cucumber, bitter gourd, musk melon, summer squash, papaya, meadow and high density orcharding of mango, guava, pomegranate and strawberry etc. besides very few flower crops.

Poly-tunnel Technology

Poly-tunnels are flexible transparent coverings that are installed over single or multiple rows of vegetables to enhance the plant growth by warming the air around



Poly - house
Source: Barton Breeze



Poly - tunnels
Source: Deposit photos

the plants in the open field during winter season when the temperature is below 8°C. Plastic low tunnels are often used to promote the growth of plants during the winter season. The farmers can grow different varieties of summer squash (round-fruited, long-fruited), along with cultivation of netted muskmelon varieties in place of traditional varieties. Bitter gourd and round melon are two other crops with increasing demand usually fetches very high price during off-season and can be grown successfully by using the plastic low tunnel technology. Poly-tunnel is also known as temporary or mobile micro-poly-house or row-cover and classified as low poly-tunnel, high poly-tunnel and trench poly-tunnel.

Plastic mulching

Plastic mulching technology, also called surface covered cultivation, largely involves mulching with polythene sheets for addressing three major issues, viz. soil and water conservation, leaching of nutrients

as well as reduction of weeds and to some extent insect pest damage. Drip irrigation is an integral part of mulching technology. Mulching involves covering the soil around the plant bases with an organic or inorganic material which makes condition more favourable for plant growth and development. Organic mulches, like leaves, straw, sawdust etc. add nutrients and humus to the soil as they decompose, improving its tilth and moisture holding capacity. Synthetic or plastic mulches have various beneficial effects on crop production.

The plastic mulch is available in different colours and each colour has its own significance:

Transparent polyethylene mulch raises the soil temperature by soil solarization and used mainly for managing soil-borne diseases, and nematodes. This effect derives mostly from the suppression of latent heat loss through evaporation.

Black polyethylene film also gives effective weed control by

cutting down solar radiation by more than 90%, resulting in etiolated growth and the eventual death of weeds under the film.

The **yellow plastic mulch** attracts insects so it can be used to attract and kill insects.

The **silver-reflective** type of plastic mulch associated with higher reflectance causes insect disorientation and repels aphids. This technology is again useful for areas with water scarcity or rainfed ecosystems, and can conserve moisture to the extent of 50% water saving and 30% nutrient saving. Thus, we can conserve resources, economies input use and efficiency and harvest 25–30% higher yields as also the quality, playing a significant role increase in income and overall upliftment of livelihood of farming families.

SUMMARY

Protected cultivation based horticultural production systems, thus, have immense uses in order to conserve the water, nutrient and energy resources besides increasing the production, generating additional income for the farmers, creating more employment opportunities in rural areas for the unemployed youth and women folk. Keeping in view the increasing demand of off-season and high value vegetables, fruits and flowers in metropolitan cities of the country, there is an urgent need for diversification of traditional agriculture by production of high value horticultural crops under different protected structures for increasing the productivity and quality produce for getting high returns. In future, there is a need to encourage environmentally degradable material for storage and handling of vegetable produce, besides adopting good agricultural practices and IPM. There is also need of developing technology for production of eco-friendly plastic and eco-friendly disposal of waste plastic.

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Plastic mulching in tomato