Hi-tech Horticulture: Introduction, Scope and importance

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Introduction

Hi tech horticulture: is a chain system of cultivation having proper linkage right from selection of seed variety for sowing to supplying to the end user. High-tech farming mainly refers to agricultural operations involving the latest technologies.

It is a capital-intensive agriculture since large capital outlay is required towards purchase of specialized equipment, maintenance of assets, training of labour, etc.

Hi-tech horticulture mainly relates to commercial farming system aimed at catering to the needs of both, domestic as well as export markets. It uses farming technology to increase yields, ensures high quality (usually pesticide-free) and realizes increased market value.

Advantages of high-technology farming

- Increase in yield up to 5 to 8 times – high productivity per unit area
- Significant saving in key inputs like water (up to 50%), fertilizers (25%) and pesticides.
- Better growth and uniformity in quality
- Feasible even in undulating terrains, saline, water logged, sandy & hilly lands

Potential areas for Hi-tech agriculture

- Urban and peri-urban areas to meet requirements of fresh produce like vegetables, fruits and flowers round the year (Resh, 2013).
- Areas with limited land and water resources
- Areas where availability of land for cultivation is restricted because of snowfall and where low temperature is prevalent restricting cultivation of crops under open field conditions.
- Small and marginal land holdings for adopting intensive production technologies
- As an agri-business enterprise for enterprising youth in rural and urban peripherals

Scope and importance of Hi-tech horticulture

Hi tech horticulture is now widely employed for the profitable commercial production of horticultural products. Hi-tech horticultural practices include

1. Integrated Pest Management (IPM)
2. Integrated Nutrient management (INM)
3. Plasticulture
4. Greenhouse Cultivation or Protected Cultivation
5. Hydroponics
6. Microirrigation or Drip irrigation
7. Fertigation
8. Precision Farming
9. High Density Planting
10. Hi-Tech Mechanization
11. Molecular Diagnostics

1. Integrated Pest Management (IPM):

- Integrated Pest Management (IPM) has become a widely practiced Hi-tech horticulture practice now (Dhaliwal et al., 2010).
- Horticultural crops are adversely affected by a variety of pests. These pests result in annual loss of over 36%.
- Integrated Pest Management in horticultural production is one of the key requirements for promoting sustainable agriculture.
- Integrated Pest Management aims at a judicious use of cultural, biological and chemical control of pests and diseases.
- Research efforts are required to develop models for application of IPM practices for important crops in different locations. With changing horticultural practices for new pests like thrips, whiteflies, mites, phytoplasma are viruses are emerging.
- To protect horticultural crops from such pests greater vigilance and stringent quarantine measures are required.

2. Integrated Nutrient management (INM):

- Integrated Nutrient Management (INM) also has become a widely practiced Hi tech horticulture practice now.
- Integrated Nutrient Management (INM) refers to maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner.

- Another important aspect of INM is the enhancing of the Fertilizer Use Efficiency (FUE) by proper placement of fertilizer in close proximity to the rhizosphere of the highest root activity.
- Integrated Nutrient Management has become one of the common practices among progressive horticulture producers today.

3. Plasticulture

- Plasticulture has become a popular hi-tech horticulture technology today. Plastics have various applications in commercial horticultural production.
- The practice of using plastics for commercial horticultural production is termed as 'Plasticulture'.
- Various applications of plastics in horticulture include Protected Cultivation (greenhouse structures; high and low tunnels etc); Plastic Mulching, and Plastic Lining. Plasticulture improves the economic efficiency of production systems and helps in efficient water and energy management (Singh and Kumar, 2016).
- Plasticulture reduces temperature fluctuations and moisture fluctuations and also helps in controlling pest and disease infestations.
- Plasticulture plays a dominant role in precise irrigation and nutrient applications by reducing wastage of water and nutrients and by reducing soil erosion.
- Use of plastics has proved beneficial to promote the judicious utilization of natural resources like soil, water, sunlight and temperature.

4. Greenhouse cultivation

Greenhouse cultivation or protected cultivation is now quite popular among progressive horticultural producers. This hi-tech horticulture technology offers several advantages over traditional production techniques such as in greenhouse cultivation, horticultural products mainly fruits, vegetables and flowers can be produced under protected cultivation even during their off seasons (Jensen and Malter, 1995).

Advantages of Greenhouses are

- Production of vegetable crops.
- Production of off-season flowers, vegetables
- Production of Roses, Carnation, cut-flowers etc.
- Plant propagation, raising of seedlings.
- Primary and secondary hardening nursery of Tissue cultured plant.
- Growth / Production of rare plants, orchids / herbs, medicinal plants

Commercial grafting techniques with computer control are available in japan for mass production of certain plants. Such machines need to be developed indigenously or need to be imported by a nodal agency in India, to standardize and perfect the technology for further dissemination (George et al., 2008).

5. Hydroponics:

Hydroponics, another hi-tech horticulture technology offers great scope for horticultural producers worldwide.

Hydroponics is also known as soilless cultivation. Hydroponics helps producers grow plants in nutrient solution, without using the standard soil medium (Resh, 2013).

6. Micro irrigation or Drip irrigation

Drip irrigation is now a widely used irrigation practice worldwide. Drip irrigation has many advantages over a standard irrigational procedure (Keller and Bliesner, 1990).

These advantages include optimum utilization of irrigational water, maximum water use efficiency by supplying water within the root system of the plants, and minimum evaporative loss of soil moisture.

7. Fertigation:

The practice of supplying plant fertilizers and nutrients via irrigational water is known as fertigation. Fertigation is usually practiced with drip irrigation (Prasad and Power, 1997).

8. Precision Farming:

Precision farming is in fact a comprehensive system designed to optimize agriculture production by carefully tailoring soil and crop management to fit the different conditions found in each field while maintaining environmental quality (Savva and Frenken, 2002).

- Precision farming means using satellite, sensors and field or thematic maps (Srinivasan, 2006).
- Precision farming also refereed as Hi-tech farming, Variable rate application farming, Site specific farming, Prescription farming (Singh and Nath, 2015).

9. High Density Planting

- Planting of fruit trees rather at a closer spacing than the recommended one using certain special techniques with the sole objective of obtaining maximum productivity per unit area without sacrificing quality is often referred as 'High density planting' or HDP.

- HDP is one of the improved production technologies to achieve the objective of: enhanced productivity of fruit crops (Chadha, 2014).
- HDP aims to achieve the twin requisites of productivity by maintaining a balance between vegetative and reproductive load without impairing the plant health.
- In India, HDP has been proved useful in many fruit crops e.g. Pineapple, banana, mango, apple and citrus.

10. Mechanization and Automation:

- Mechanization and Automation has not yet been fully exploited for the benefit of Indian Agriculture.
- Mechanization of agriculture is an essential input in modern agriculture. It enhances productivity, besides reducing human drudgery and cost of cultivation.
- Mechanization also helps in improving utilization efficiency of other inputs, safety and comfort of the agricultural worker, improvements in the quality and value addition of the produce (Srivastava et al., 2006).
- In horticultural crops these efforts should help in vegetative propagation, planting and pruning of plants, harvesting grading and post-harvest management including value addition.
- Separation through conventional and modern techniques and gadgets based on photometry, short wave radiation, machine vision and laser technology hold promise to meet quality standards for markets and operations down the line including value addition
- Appropriate field heat removal techniques: cold air system, hydro-cooling, vacuum cooling or slush system need to be adopted in the field level (in situ)
- Processing and value addition: Minimally processed for quick cooking of vegetables and their products, which are prepared with intermediate moisture and hurdle technology, have great potential in the civil sector besides the defence sector.
- These conventional foods can be stored without refrigeration and can be marketed in both domestic and international markets.
- Entrepreneurship in this area needs to be promoted. Designer foods developed by Defence Food Research Laboratory can go as calorie specific functional foods in the civil sector in the field of nutrition.

11. Molecular Diagnostics:

- New biology for developing improved cultivars of horticultural crops. Molecular characterisation is very important for IPR, patenting an safeguarding against gene piracy (Singh and Nath, 2015).
- Molecular marker-aided-selection and genetic engineering will have to be employed in future genetic improvement of horticultural crops.
- Isolation of somaclonal and protoclonal variation and in vitro mutagenesis need to be exploited.
- Use of molecular methods of transferring male sterility need to be exploited for development of hybrids (Singh, 2015).
- Hi tech propagation of horticultural crops micro propagation has emerged as an important tool for quick production of large number of plants. It is already being exploited in crops like banana, capsicum, tomato, chilli and several ornamental plants.
- There is also need to develop protocols for micropropagation in crops like mango, cashew, litchi and other important crops.
- Thrust on quality and avoidance of contamination hold the key for the success of indial tissue culture industry.
- Further innovative management practices like efficient use of techniques, such as low cost polythene bags for multiplication and raising of plantlets, cheaper laminar flow facilities with more capacity, minimum contamination and faster sterilization need to be developed and standardised.

Conclusion

Hi-tech horticulture has emerged as a vital and transformative approach for achieving sustainable, efficient and profitable horticultural production in the present era of shrinking natural resources and increasing market demand. By integrating advanced technologies from seed selection to post-harvest handling and marketing, hi-tech horticulture ensures higher productivity, superior quality produce and better resource-use efficiency.

The adoption of practices such as Integrated Pest Management, Integrated Nutrient Management, plasticulture, protected cultivation, hydroponics, micro-irrigation, fertigation, precision farming and high-density planting has significantly enhanced yield levels while reducing dependency on water, fertilizers and pesticides. These technologies not only contribute to environmental

sustainability but also enable cultivation in adverse and marginal agro-climatic conditions where conventional farming is limited. Mechanization, automation and molecular diagnostics further strengthen hi-tech horticulture by improving labour efficiency, crop quality, disease management and varietal improvement.

Overall, hi-tech horticulture offers immense scope for increasing farmers' income, promoting agri-entrepreneurship and meeting the growing demand for safe, high-quality horticultural produce in domestic and export markets. With appropriate policy support, capacity building, research and technology dissemination, hi-tech horticulture can play a crucial role in ensuring food and nutritional security, employment generation and sustainable agricultural development.

References:

Chadha, K. L. (Ed.). (2014). *Handbook of Horticulture*. New Delhi: Indian Council of Agricultural Research (ICAR).

Dhaliwal, G. S., Jindal, V., & Dhawan, A. K. (2010). *Integrated Pest Management: Concepts and Approaches*. New Delhi: Kalyani Publishers.

George, E. F., Hall, M. A., & De Klerk, G. J. (2008). *Plant Propagation by Tissue Culture*. Dordrecht: Springer.

Jensen, M. H., & Malter, A. J. (1995). *Protected Agriculture: A Global Review*. Washington DC: World Bank.

Keller, J., & Bliesner, R. D. (1990). *Sprinkler and Trickle Irrigation*. New York: Van Nostrand Reinhold.

Prasad, R., & Power, J. F. (1997). *Soil Fertility Management for Sustainable Agriculture*. Boca Raton: CRC Press.

Resh, H. M. (2013). *Hydroponic Food Production: A Definitive Guidebook*. Boca Raton: CRC Press.

Savva, A. P., & Frenken, K. (2002). *Irrigation Manual: Planning, Development, Monitoring and Evaluation of Irrigated Agriculture*. FAO Land and Water Development Division.

Singh, B. D. (2015). *Plant Breeding: Principles and Methods*. New Delhi: Kalyani Publishers.

Singh, B., & Kumar, P. (2016). Plasticulture in horticulture: A review. *Indian Journal of Agricultural Sciences*, 86(7), 829–838.

Singh, H. P., & Nath, P. (2015). *Hi-tech Horticulture*. New Delhi: Westville Publishing House.

Srinivasan, A. (2006). *Precision Agriculture: Principles and Applications*. New Delhi: ICAR.

Srivastava, A. K., Goering, C. E., Rohrbach, R. P., & Buckmaster, D. R. (2006). *Engineering Principles of Agricultural Machines*. St. Joseph, MI: ASABE.

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