ISBN: 978-93-94570-42-9

The Need and Prospects for New Approaches in Horticultural Crop Production

Rambir Singh

Assistant Professor,
Department of Geography,
Ch. Bansi Lal Govt. College for Women Tosham (Bhiwani).

Abstract:

Horticultural crops are an integral aspect of daily life and serve a social function in influencing human lifestyles, enhancing landscapes, and forming human culture. However, there are numerous difficulties in growing horticulture crops, including the urbanisation of the world's population, environmental issues, the efficient use of resources, and problems with the environment and human health brought on by the excessive use of pesticides. Horticultural experts must concentrate on developing innovative technologies to lessen the demand for human labour and boost productivity in order to tackle these problems. Horticultural crops require complicated post-harvest processing before consumption, are difficult to grow and manage, are vulnerable to pests and diseases, and require additional planting control.Flavor and quality are typically diminished as a result of significant losses during processing, warehousing, transit, and sale. To guarantee food and nutritional security for humanity, a combination of high-tech cultivation techniques and post harvest management of horticulture crops is required. The need to boost production, earnings, and productivity heavily influenced the technologies that were available to farmers. The sector has to accomplish multiple aims, such as being internationally competitive, producing agricultural goods of high quality while achieving sustainability requirements. The horticulture industries face many issues, and innovation is essential to finding solutions. New concepts, technologies, and methods will be vital in assisting farmers, growers, and enterprises to become more productive and sustainable.

Keywords:

Horticulture, Innovation, Productivity, Smart Farming, Sustainability

7.1 Introduction:

Horticultural crops, which mostly include fruits, vegetables, ingredients for beverages and fragrances, herbal medicines, and ornamental plants, play a significant role in our daily lives. Horticultural crops now serve a social role in moulding human culture, enhancing landscapes, and influencing human lifestyles in addition to their economic significance in supplying food as contemporary society advances (Litt et al., 2011). Horticultural workers have been motivated to produce more types and better products as a result of this change in duties, which is becoming increasingly significant. Also, it motivates researchers in horticulture to conduct more useful work to enhance the functional applications of horticultural crops(Yang& Xu,2021).However, establishing horticulture crops requires a lot of delicate manual labour that significantly relies on skilled personnel to complete tasks like pruning branches, thinning flowers and fruit, picking fruit and controlling insect and pest infestations. Present day horticultural crop production has a number of obstacles(Muendo&Tschirley,2004). These issues stem from a number of root causes, including an increasing global population that is skewed towards urban populations and consumes rather than produces our food supply, the increased negative impact of environmental issues that reduce crop yield and restrict the availability of arable land, problems with resource use efficiency to limit chemical releases into the environment, and an increase in the use of pesticides, fungicides, bactericides, herbicides, and other chemical control agents(Lastochkina et al., 2022). It is necessary to increase crop output without considerably increasing the amount of land, water, or fertiliser used (Zhang et al., 2011).Horticultural researchers must focus on developing new technologies in order to make better orchard management decisions and dramatically increase horticultural output in order to meet the upcoming needs and challenges (Pearce et al., 2018). Consequently, the main objective of intelligent horticulture is to produce high-quality fruits, vegetables, and decorative crops by utilising cutting-edge technology, tools, and systems to decrease the use of human force and increase its effectiveness.

7.2 Challenges in Research and Production of Horticultural Crops:

The quantity and quality of horticulture crops have significantly increased in the twenty-first century as a result of the advancement of agricultural technology. These gains, nevertheless, still fall short of what the constantly expanding population needs. According to estimates, the population of the world was at 7 billion in 2020 and will increase to 9 billion by 2050. There will be decreasing and lesser land accessible for farming due to severe issues like global warming, desertification, and environmental contamination, and securing food supply and security is already a difficult task (Jamnadass et al., 2020). Sustainability has been a big problem for agriculture since horticulture production is coming under more and more pressure (Tilman et al., 2002). The cultivation of horticultural crops presents a number of unique challenges or issues as compared to the production of stable crops such as rice, wheat, maize etc.

For the majority of horticultural crops, lengthier breeding cycles are needed, and quality enhancement has become more important. Perennial fruit trees with long juvenile periods are frequently bred using conventional techniques like mutation and crossing. However, they frequently require labor- and time-intensive cutting or grafting propagation in order to guarantee genetic stability or acquire superior features, respectively. While developing tea cultivars, for instance, lines are initially chosen by hybridization or from natural populations, then they are reproduced by cutting, and the lines with the best features are found after planting for three years.Typically, the procedure takes longer than 10 years. Horticultural crops have essential quality attributes including scent, taste, and colour as breeding targets since these features affect the crop's nutritional and economic worth. Long-term focus in breeding has been on produce, whereas flavour characteristics have been disregarded (Gao et al., 2019; Zhu et al., 2019). Second, it is technically more challenging to grow and manage horticultural crops. They come in a variety of kinds, and the most of them are perennials that have been regularly cultivated for many years, if not decades.

Horticultural crops are hence more susceptible to pests and illnesses.In order to provide the essential conditions for the growth and harvest of horticultural crops, greenhouses or other facilities are sometimes needed (Castilla & Hernandez, 2006; Eigenbrod&Gruda, 2015). As a result, it is clear that, in general terms, horticultural crops demand more work and better planting management. Last but not least, because horticultural commodities have a high rate of post-harvest loss, the majority of fruits, vegetables, and flowers need to be stored fresh (Kasso& Bekele, 2018; Kader & Rolle, 2004).

Before being consumed, several horticultural crops need intricate post-harvest processing.For instance, following harvest, the fresh leaves of tea trees must be processed into green, black, or oolong tea or other types of tea, which necessitates thorough metabolism of fresh tea leaves' constituents (Zeng et al., 2020). Similar to bitter almonds, Prunus dulcis, harmful cyanogenic glucosides must be removed through processing before eating (Cortés et al., 2019). Usually, significant losses during production, storage, shipping, and sale lead to a decline in both flavour and quality.

7.3 Need for New Approaches in Horticulture:

Horticulture is one of the finest solutions for increasing land productivity, providing human nutrition security, and maintaining the livelihood of the farming community globally. This is a well-known fact. By 2050, the world's population is expected to reach 9 billion, with the majority of that growth occurring in underdeveloped nations where malnutrition and chronic food shortages currently predominate. Due to overexploitation of natural resources, this anticipated population growth would undoubtedly result in a decrease in the per capita availability of natural resources, which will ultimately increase hunger, poverty, and malnutrition as well as raise food costs.So, it is essential and imperative to address the wise use of natural resources.

The world's agriculture is now being seriously threatened by climate change (Malhotra, 2017; Datta, 2013). Throughout the past century, the earth's surface temperatures have increased dramatically, with agriculture being the sector most affected.

The increase in temperature increases the rate of respiration, shortens the duration between crops, hastens crop maturity, and accelerates ripening, all of which have a negative impact on agricultural output. Climate change is the primary cause and trigger of a number of climatic extremes, including droughts, floods, tropical cyclones, heavy precipitation events, hot extremes, and heat waves that have a detrimental effect on agriculture.

Precision farming, which involves managing resources in time and space for horticulture, is one of the key high-tech interventions needed to optimise resource usage. The goal of technology infusion is to increase crop productivity per unit of inputs by making the best use of available resources (Srivastava & Singh, 2022). Only the use of contemporary high-tech apps and precision farming techniques would make this viable. These technologies need to be broadly used and implemented in order to increase agricultural output and returns to farmers.A collection of high-tech cultivation techniques and postharvest management of horticultural crops is required, given the horticulturist's challenges listed above and their expected role in guaranteeing food and nutritional security for humanity.

7.4 Prospects for New Approaches in Horticulture:

Up until recently, farmers' ability to choose among a variety of technologies was mostly influenced by the need to boost output, profits, and productivity (Johnston & Mellor, 1961). The primary obstacles were a lack of cash, a lack of technological expertise, and market hazards against which government measures protected many nations' policies. As the goal of agricultural policies was to raise production, "good policy practises" used to be very straightforward and mostly related to raising output. For instance, agricultural and horticultural research and extension services could focus on enhancing small farms' output (Hazell, 2005). Currently, agriculture must accomplish a number of goals, including being internationally competitive, producing high-quality agricultural goods, and achieving sustainability goals (Garnett &Godfray, 2012). Agricultural producers want quick access to innovative technologies in order to stay competitive. Farmers now have both more opportunity and much more restrictions. They must not only be successful but also adhere to environmental laws and norms. Consumers may also be overwhelmed with information from numerous government and business sources, that make choosing acceptable technology more difficult. Farmers must adapt their management and production methods in response to agricultural regulations that take environmental factors into account (Mertz et al., 2009). Future events could see an even greater rise in uncertainty. The future policy environment may also be uncertain, particularly in light of support, trade, and challenges from the agro-food sector. Farming technology adoption requires financial investment. Yet, it takes time for the benefits to materialise, and farmers could be hesitant to make investments in an unstable environment with more restrictions, where part of the advantages are for society.

The foundation for boosting development and productivity has been technological advancement. With the development of new technologies, research influences the productivity of farming systems. If these technologies are suitable for farmers' needs, they will be quickly implemented. To address the issues the horticultural industries are currently facing, innovation is essential (Alaie, 2023). For farmers, producers, and enterprises to become more productive, new concepts, technology, and methods will be crucial. They will also make the industry more robust and environmentally sustainable. Fruits and vegetables play a crucial role in combating the triple dangers of hunger, micronutrient deficiencies, and overnutrition thanks to elements of the value chain for horticulture commodities that create jobs and open new market opportunities.Horticultural crops contribute to wealth generation because they are often high value crops. The growth of horticulture is thought to benefit greatly from the advances made in basic research and new technologies, such as multi-omics technique, gene editing, big data mining, cloud computing, and novel sensor instruments (Gimode et al., 2021; Jha et al., 2019; Huang et al., 2016). Multi-omics, single-cell sequencing, genetic mapping, genetic engineering, cultivation, and post-harvest processing are a few examples of the interdisciplinary methodologies that could be integrated to produce new insights into crop improvement, domestication, evolution, storage, and synthetic biology.Modern agriculture has been fundamentally revolutionised by new technological discoveries, including robotics, drones, and computer vision software. These developments are still making their way forward, opening the door to new innovations and efficiencies. Several new data opportunities have arisen as a result of the development of digital agriculture and the technology that support it. During the course of a whole field, information can be gathered continuously by remote sensors, satellites, and Drones.

They can keep an eye on things like soil quality, humidity, temperature, and plant health.In recent years, horticulture has made sustainability one of its main objectives. This entails taking action in response to environmental factors, good agricultural practises, biodiversity preservation, and novel plant breeding techniques.

7.5 Conclusion:

Horticultural crops serve a crucial part in human life by providing us with food, beverages and decorative items. It is exciting that, as a result of amazing technological developments and very beneficial joint efforts, there has been significant program-based progress and success in the field of horticulture research. The issues brought on by population increase, the precipitous depletion of land resources, and the dangers posed by pests and illnesses are getting worse. In light of these facts, the future of horticultural research will revolve around the selection of superior varieties, efficient prevention and management of pests and diseases, and maintaining quality and yield to satisfy human needs while protecting the environment.Researchers should boost post-harvest storage and processing procedures for horticulture goods, optimise cultivation and management practises, and innovate the use of genetic resources. Particularly, we must meet the obstacles in terms of preservation and characterisation of the natural genetic variety of horticulture crops before adopting the revolutionary technology.The adoption of multi-disciplinary tools and contemporary biology and AI technologies will be effective to address horticultureproblems by highlighting the traits and significance of horticultural crops and summarising the major challenges anticipated in the future horticultural production process, including breeding, planting management, harvesting, and post-harvest processes. Researchers should work to accomplish sustainable development of smart horticulture, which has significant potential for future horticultural output, in addition to closely relating horticultural products and market consumption.

7.6 References:

1. Alaie, S. (2023). Innovation and Sustainability Dynamics in the Horticultural Sector. Sustainability, Agri, Food and Environmental Research, 11.
2. Castilla, N., & Hernandez, J. (2006). Greenhouse technological packages for high-quality crop production. In XXVII International Horticultural Congress-IHC2006: International Symposium on Advances in Environmental Control, Automation 761 (pp. 285-297).
3. Cortés, V., Talens, P., Barat, J.M. & Lerma-García, M.J. (2019) Discrimination of intact almonds according to their bitterness and prediction of amygdalin concentration by Fourier transform infrared spectroscopy. Postharvest Biology and Technology, 148, 236–241.
4. Datta, S. (2013). Impact of climate change in Indian horticulture-a review. International journal of science, environment and technology, 2(4), 661-671.
5. Eigenbrod, C., & Gruda, N. (2015). Urban vegetable for food security in cities. A review. Agronomy for Sustainable Development, 35, 483-498.
6. Gao, L., Gonda, I., Sun, H., Ma, Q., Bao, K., Tieman, D. M., ... & Fei, Z. (2019). The tomato pan-genome uncovers new genes and a rare allele regulating fruit flavor. Nature genetics, 51(6), 1044-1051.

7. Garnett, T., & Godfray, C. (2012). Sustainable intensification in agriculture. Navigating a course through competing food system priorities. Food climate research network and the Oxford Martin programme on the future of food, University of Oxford, UK, 51.
8. Gimode, W., Bao, K., Fei, Z. & McGregor, C. (2021) QTL associated with gummy stem blight resistance in watermelon. TAG. Theoretical and Applied Genetics., 134, 573–584.
9. Hazell, P. B. (2005). Is there a future for small farms? Agricultural Economics, 32, 93-101.
10. Huang, S., Li, R., Zhang, Z., Li, L.I., Gu, X., Fan, W. et al. (2009) The genome of the cucumber, Cucumis sativus L. Nature Genetics, 41, 1275–1281.
11. Jamnadass, R., Mumm, R. H., Hale, I., Hendre, P., Muchugi, A., Dawson, I. K., & Van Deynze, A. (2020). Enhancing African orphan crops with genomics. Nature Genetics, 52(4), 356-360.
12. Jha, K., Doshi, A., Patel, P. & Shah, M. (2019) A comprehensive review on automation in agriculture using artificial intelligence. Artificial Intelligence in Agriculture, 2, 1–12.
13. Johnston, B. F., & Mellor, J. W. (1961). The role of agriculture in economic development. The American Economic Review, 51(4), 566-593.
14. Kader, A. A., & Rolle, R. S. (2004). The role of post-harvest management in assuring the quality and safety of horticultural produce (Vol. 152). Food & Agriculture Org.
15. Kasso, M., & Bekele, A. (2018). Post-harvest loss and quality deterioration of horticultural crops in Dire Dawa Region, Ethiopia. Journal of the Saudi Society of Agricultural Sciences, 17(1), 88-96.
16. Lastochkina, O., Aliniaeifard, S., SeifiKalhor, M., Bosacchi, M., Maslennikova, D., & Lubyanova, A. (2022). Novel Approaches for Sustainable Horticultural Crop Production: Advances and Prospects. Horticulturae, 8(10), 910.
17. Litt, J. S., Soobader, M. J., Turbin, M. S., Hale, J. W., Buchenau, M., & Marshall, J. A. (2011). The influence of social involvement, neighborhood aesthetics, and community garden participation on fruit and vegetable consumption. American journal of public health, 101(8), 1466-1473.
18. Malhotra, S. K. (2017). Horticultural crops and climate change: A review. Indian Journal of Agricultural Sciences, 87(1), 12-22.
19. Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2009). Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel. Environmental management, 43, 804-816.
20. Muendo, K. M., & Tschirley, D. L. (2004). Improving Kenya's Domestic Horticultural Production and Marketing System: Current Competitiveness, Forces of Change, and Challenges for the Future Volume I: Horticultural Production (No. 680-2016-46735).
21. Pearce, D., Dora, M., Wesana, J., & Gellynck, X. (2018). Determining factors driving sustainable performance through the application of lean management practices in horticultural primary production. Journal of Cleaner Production, 203, 400-417.
22. Srivastava, J. N., & Singh, A. K. (Eds.). (2022). Diseases of Horticultural Crops: Diagnosis and Management: Volume 1: Fruit Crops. CRC Press.
23. Tilman, D., Cassman, K. G., Matson, P. A., Naylor, R., & Polasky, S. (2002). Agricultural sustainability and intensive production practices. Nature, 418(6898), 671-677.
24. Yang, B., & Xu, Y. (2021). Applications of deep-learning approaches in horticultural research: a review. Horticulture Research, 8.

25. Zeng, L., Zhou, X., Su, X. & Yang, Z. (2020) Chinese oolong tea: an aromatic beverage produced under multiple stresses. Trends in Food Science & Technology, 106, 242–253.
26. Zhang, F., Cui, Z., Fan, M., Zhang, W., Chen, X., & Jiang, R. (2011). Integrated soil–crop system management: reducing environmental risk while increasing crop productivity and improving nutrient use efficiency in China. Journal of Environmental Quality, 40(4), 1051-1057.
27. Zhu, G., Gou, J., Klee, H., & Huang, S. (2019). Next-gen approaches to flavor-related metabolism. Annual Review of Plant Biology, 70, 187-212.