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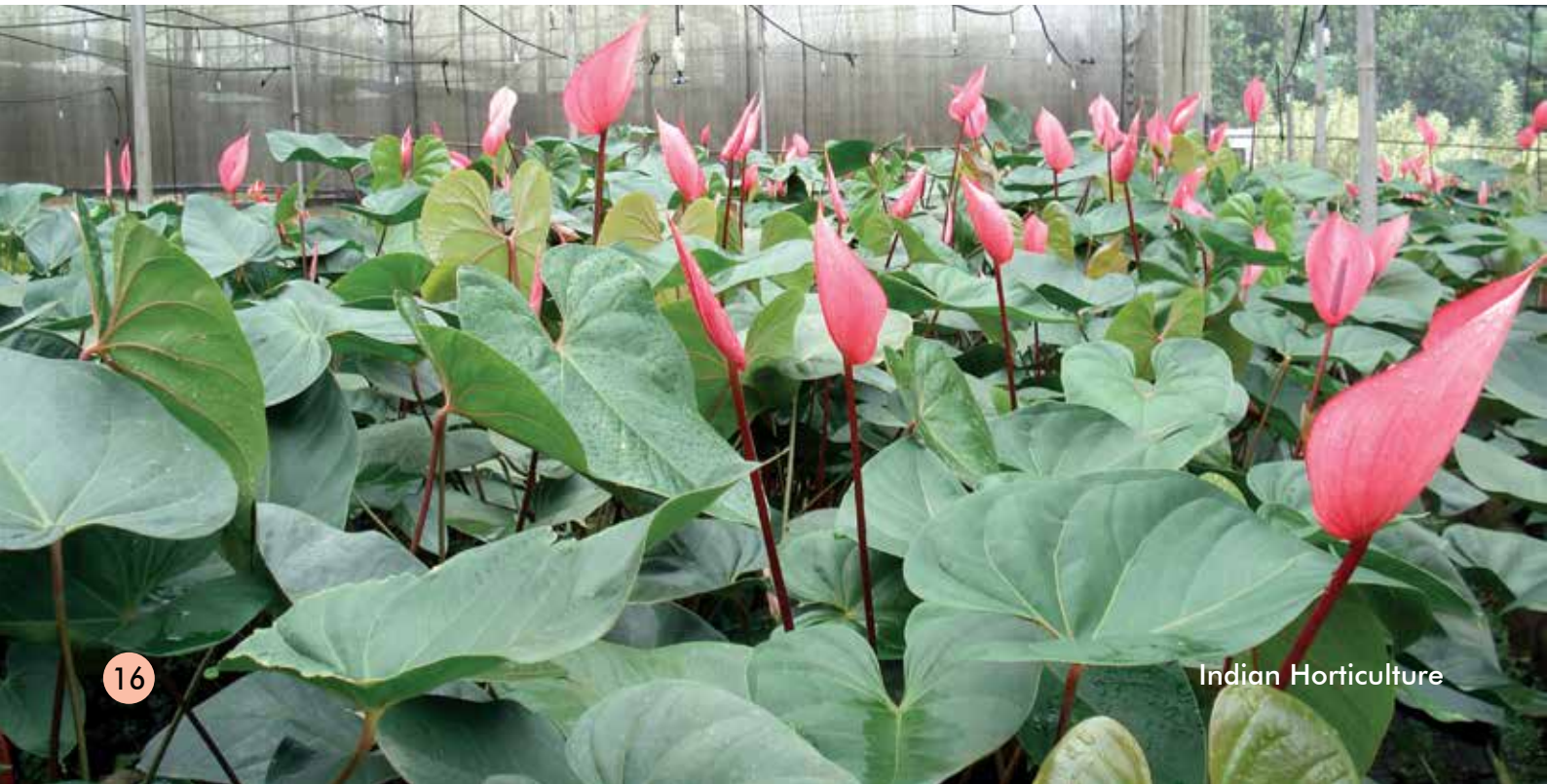
Smart hi-tech floriculture options

In recent decades, technological advancements have transformed the floriculture sector, with modern farming methods like protected cultivation and the integration of smart technologies driving significant growth. This article explores the adoption of cutting-edge tools such as IoT-based automation systems, artificial intelligence (AI), and cloud computing, which are revolutionizing flower cultivation, post-harvest management, and quality control. Protected cultivation under polyhouses allows for optimal control of climatic factors, resulting in high-quality export-grade flowers. IoT-driven automation for fertigation and climate control further enhances efficiency and reduces labour costs. AI has emerged as a powerful tool in floriculture, offering predictive analytics for pest management, optimizing growing conditions, and boosting plant resilience. The use of automated post-harvest machinery also ensures longer shelf-life and reduced losses. While these technologies have immense potential, widespread adoption in India requires further research, training, and awareness. The future of Indian floriculture looks promising as AI and other smart technologies continue to foster innovation, sustainability, and productivity in the sector.

INDIA has a variety of agroclimatic zones that are ideal for growing delicate and sensitive flowers. The floriculture business had notable expansion in the export market 10 years after liberalization. Production for sustenance has dynamically shifted to production for commercial consumption during this era. According to the National Horticulture Database-2020-21 (by the National Horticulture Board), the area under floriculture production in India encompassed 322 thousand ha, yielding 2,152 thousand tonnes of loose flowers and 828 thousand tonnes of cut flowers. For commercial purposes, they are presently cultivated in several states, with the highest cultivation area in states such as Kerala (16.5%), Tamil Nadu (13.3%), Karnataka (11.4%), Madhya Pradesh (11.1%), and Uttar Pradesh (7%) which have surpassed other producing states like Andhra Pradesh, West Bengal,

Liliums



Chrysanthemum

Hybrid tea roses

Mizoram, Gujarat, Odisha, Jharkhand, Haryana, Assam, and Chhattisgarh.

Indian floriculture industry comprises various floral species including rose, tuberose, gladiolus, anthurium, carnations, marigold, etc. Cultivation is practiced in both open field conditions and protected cultivation. Although floriculture, or the production of flowers, has long been practiced by Indian farmers, the utilization of flowers was historically confined to spiritual events and religious ceremonies. However, the pattern of flower usage transformed in the last decade of the 20th century, with people increasingly decorating and displaying cut flowers of various colours, varieties, and sizes in vases within their homes appreciating their aesthetic value. This shift in consumer preferences led to an increased demand for cut flowers, prompting farmers and growers to adopt modern, technologically advanced farming methods for flower cultivation beginning in 1990. These approaches aimed to enhance production, improve quality, and extend the vase life of flowers.

The use of smart technologies including protected structures, tissue cultured/grafted varieties, micro-irrigation systems with automation for irrigation and nutrient management, use of biopesticides through the latest triplex high-pressure low-volume pumps, climate control equipment for maintaining consistent climate conditions throughout the year thereby ensuring uniform flower quality round the year, and advanced post-harvest machines for automatic grading, sorting, packaging of flowers and cold storage facilities to maintain the quality of harvested flowers.

A new generation of information technologies, including the Internet of Things (IoT), big data, cloud computing, artificial intelligence (AI), and blockchain, is undergoing rapid development. These technologies have the potential to transform industrial applications into modern agricultural applications, thereby facilitating the emergence of new industries. This article elucidates some of the latest smart technologies used by Indian farmers.

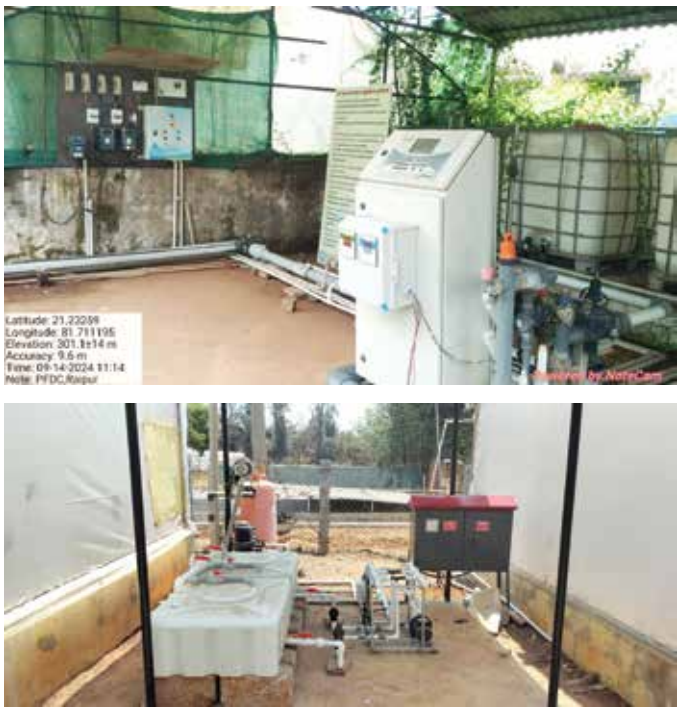
Protected cultivation technology

Naturally ventilated polyhouses are optimally suited for flower cultivation under protected cultivation in India. Farmers have been growing roses (Hybrid Teas), gerbera, carnations, chrysanthemum, orchids, anthuriums, gypsophilla etc. for over two decades, exporting roses, orchids and other species to various countries including Japan, Holland, Singapore, Gulf nations, England etc. from October to May.

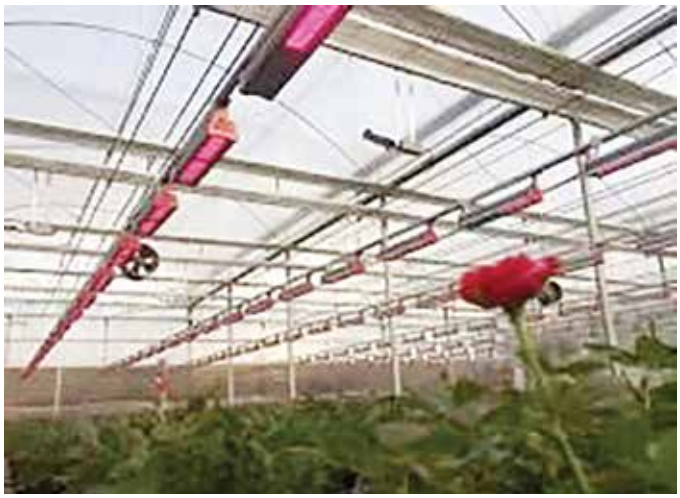
A polyhouse is a structure covered with a transparent material under which plants can be cultivated in partially or fully controlled climatic conditions. The production of high-quality flowers is dependent on climatic factors such as temperature, humidity, light, and air movement. The polyhouse structure, in conjunction with auxiliary devices, ensures that these climatic factors are regulated to meet the optimal requirements of the crop, irrespective of external conditions. Greenhouse technology enables farmers to cultivate export-quality flowers throughout the year and achieve multiple harvests per unit area compared to open field cultivation. Such technologies are gaining increasing popularity among Indian farmers.

IoT-based automation systems for fertigation

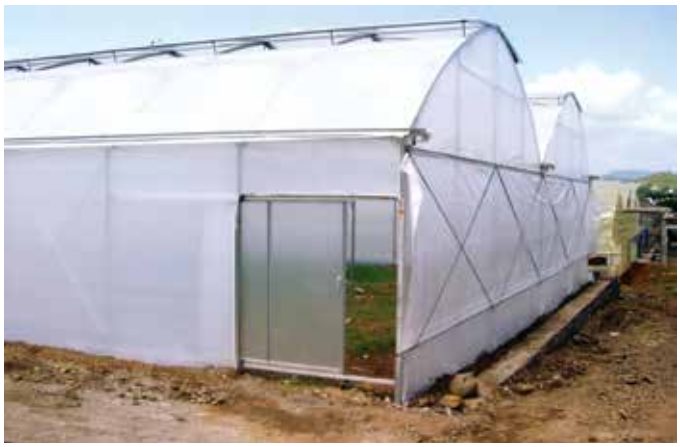
The optimal provision of high-quality water and nutrients is one of the most critical factors for quality flower production. Internet of Things (IoT) cloud-based automation systems, despite their high initial costs, deliver



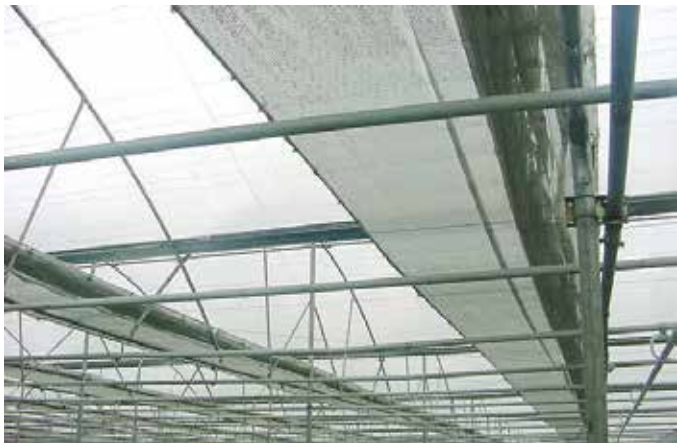
IoT cloud based automation systems for supply of water and fertilizers to the plants



Artificial lighting in greenhouses



IoT-based maxi-vent auto greenhouse



Auto control of light and ventilation in greenhouses

water and nutrients to plants in a balanced manner under controlled electrical conductivity (EC) and pH of water and media. This system significantly conserves water, fertilizers, and labour compared to traditional methods, thereby reducing production costs and enhancing both the quality and quantity of flowers per unit area.

IoT/cloud-based automation in climate control in greenhouses

Farmers often employ manual controls for controlling climatic factors and maintain them within desired ranges. However, it is labour-intensive and time-consuming. The précised use of IoT-based climate control systems assists farmers in regulating and maintaining climatic factors within the desired range without the need for manual labour, that too promptly. When a climatic factor like temperature exceeds the desired range, the pad fan system or exhaust fans or fogging system automatically activates to bring temperature within a specific range and these systems operate continuously throughout the day and night, governed by specific software. Manual activation or deactivation is not necessary, as these systems work automatically based on the data input into the software.

Smart technologies in floriculture in post-harvest management

Post-harvest management of flowers is a critical aspect of the floriculture industry. Appropriate post-harvest treatments and management practices enable growers to maintain the freshness of flowers until they reach consumers (domestically or internationally) and extend their shelf-life. Initially, farmers employed manual post-harvest operations like grading, sorting, bunching, packaging etc. which might present a risk of damaging the petals or leaves of the flowers thereby, diminishing quality and consequently, returns. Such manual processing and resultant damage led to the rejection of entire export shipments of flowers, resulting in substantial financial losses. To mitigate such losses, it became necessary to use sophisticated automated post-harvest machinery thereby reducing labour costs and enhancing the quality

Cold storage for harvested flowers

Cleaning, grading, sorting and packing combo machine
(Source: http://www.sonerkazaz.com)

and shelf-life of flowers. An additional advantage of employing such machines is their efficiency, which is five to six times greater than that of the skilled workers performing the same operation manually. Currently, the majority of corporate flower growers use automated post-harvest machines, cold storage facilities and refrigerated vehicles for transporting flowers to markets, airports and other destinations.

Training and awareness to farmers to adopt such smart technologies

The concept of utilizing smart technologies in floriculture, although 25 years old in India, necessitates training, skill development, and awareness of end users due to its significant divergence from traditional open farming practices. Substantial research in this field is required, in contrast to merely adopting technology from The Netherlands or Israel.

Various Precision Farming Development Centers (PFDCs) were established under NHM/MIDH by the Ministry of Agriculture & Farmers Welfare, GoI affiliated with diverse State Agricultural Universities, ICAR, and IIT, Kharagpur. The primary aim of PFDCs is to carry out applied research in precision agriculture and plasticulture products, including protected cultivation; demonstrate cultivation of flowers and vegetables under protected structures and in open fields; and implement training and awareness programs for farmers in the domain of precision farming and protected cultivation techniques. There are 22 such PFDCs throughout India, managed by the National Committee on Precision Agriculture & Horticulture (NCPAH), assisting farmers in achieving success in protected cultivation.

Use of Artificial Intelligence (AI) in floriculture

Artificial Intelligence (AI) is a domain within computer science that focuses on the development of systems and algorithms capable of executing tasks traditionally associated with human cognitive functions. Artificial Intelligence (AI) addresses specific and limited tasks, like data analysis or voice recognition, and endeavours to create systems with intelligence comparable to human cognition across various tasks and contexts. AI uses a variety of techniques to accomplish these goals, such as machine learning, which involves training computers using large datasets to enhance their performance.

AI-based computer-controlled system for maintaining climatic factors in the optimum range

Artificial Intelligence (AI) is growing and impacting several domains of society, driving breakthroughs and progress in fields like agriculture sciences, healthcare, and education.

Artificial Intelligence (AI) has become increasingly popular in research related to floriculture in recent years. This development reveals a considerable shift in the industry as scientists and growers take advantage of AI to enhance ornamental plant production in quantity and quality. AI's efficiency in analyzing large volumes of data and spotting minute patterns has been pivotal in hastening the creation of new flower varieties as well as enhancing the efficiency and accuracy of genetic improvement.

AI also facilitate the early detection of pests and diseases, aiding in the defence of ornamental plants against possible threats. AI's integration into floriculture research can comprehensively transform the sector by promoting innovation, sustainability, and the creation of better and more aesthetically pleasing flowers as the technology develops and becomes more widely available. AI offers a wide range of tools to boost cultivation at every stage, from planting to harvesting. AI can precisely alter the optimal conditions for the growth of many flower varieties by monitoring environmental elements including temperature, humidity, light, and nutrient levels through real-time data collection and processing. Further, AI systems can precisely forecast the best times to apply fertilizer and irrigation, saving resources and time besides guaranteeing more effective utilization. This conscientious process not only enhances the quality of the flowers produced but also improves the health of the plants and productivity.

The future of artificial intelligence in the floriculture industry is promising. AI is projected to continue to remarkably influence the floriculture sector, propelling striking breakthroughs. One of the most prominent trends is personalization. Further, with enhanced automation, like robotic harvesting, waste can be minimized, expenses can be cut, and production efficiency can be increased. Artificial intelligence research can also be channelled

Anthuriums

to bolster plants' resilience to adverse environments, boosting their sustainability and robustness. AI has the potential to transform the floriculture industry by driving innovation and efficiency in flower cultivation, marketing, and customer satisfaction. This is due to the growing amount of data available and the continual improvement of machine learning algorithms. Let us hope for an exciting and transformative future where artificial intelligence and floriculture work simultaneously.

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