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*Editorial*

# Orchard Management Under Climate Change: 2nd Edition

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## 1. Introduction

Climate change continues to be one of the most significant challenges facing global horticultural production. Increasing temperatures, changes in rainfall distribution, more frequent drought events, heat waves, late frosts, and extreme weather phenomena are affecting orchard productivity, fruit quality, resource use efficiency, and the long-term sustainability of fruit production systems worldwide [1–4]. Recent studies have demonstrated that climate change influences crop phenology, flowering dynamics, fruit development, water requirements, and pest and disease incidence, thereby requiring substantial adjustments in orchard management practices [1,2]. Furthermore, the increasing frequency of extreme weather events poses additional risks to fruit production systems, threatening both yield stability and economic viability [3].

To address these challenges, researchers, growers, and industry stakeholders have intensified efforts to develop innovative orchard management strategies that improve resilience and adaptation under changing environmental conditions. These strategies include improved irrigation management, precision agriculture technologies, optimized canopy architecture, climate-adapted cultivars and rootstocks, and advanced monitoring systems for environmental and crop responses [2,4].

The Special Issue "Orchard Management Under Climate Change: 2nd Edition" was organized to provide an international forum for presenting recent advances related to climate adaptation in fruit production systems. The published papers address a wide range of topics, including irrigation management, physiological responses to abiotic stress, nutritional diagnosis, crop phenology, rootstock selection, precision horticulture, and the expansion of fruit crops into new production regions.

The contributions collected in this Special Issue provide valuable scientific knowledge that supports the development of sustainable orchard systems capable of maintaining productivity and fruit quality under future climatic scenarios.

## 2. Overview of Published Articles

The Special Issue comprises original research articles and review papers covering several fruit crops and production systems across different climatic regions.

Water availability and drought adaptation were major themes among the published studies. Research involving 'Hass' avocado conducted by Kanedo et al. (Contribution 1) demonstrated the importance of optimized irrigation management under increasingly frequent drought conditions. The authors described that water deficits can negatively

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affect fruit growth and yield, highlighting the need for improved irrigation scheduling and water-use efficiency strategies.

In another paper, Jitariu et al. (Contribution 2) provided a comprehensive assessment of potential changes in the growing season of plum orchards in Romania under different climate change scenarios. By integrating temperature-based phenological modeling, the authors identified a consistent trend toward an earlier onset and an extended duration of the growing season across all analyzed regions. Their findings suggest that ongoing climate change may substantially alter plum phenology, with important implications for orchard management, production practices, and the long-term sustainability of plum cultivation in Romania.

Precision horticulture and climate-based crop management were addressed in a review article by Fotouo Makouate et al. (Contribution 3), which discussed the advances in growing degree day models, environmental sensing technologies, remote sensing applications, and digital agriculture tools. The review highlighted the growing importance of integrating climate information and precision management technologies into orchard decision-making processes.

Moving towards another interesting cultivation, Brawner et al. (Contribution 4) investigated if a modified harvester height was suitable for cider apple harvest in the US. The study included 16 cider apples cultivars to assess the modified Oxbo-Korvan 930 over-the-row harvester. The authors concluded that the equipment is suitable for cider apple production and requires 40-fold less time than hand harvesting, making it significantly more labor-efficient.

Nutritional management under changing climatic conditions was addressed through a study focused on the development of updated nutritional diagnostic standards for avocado by Almeida de Oliveira Junior et al. (Contribution 5). Using DRIS and CND methodologies, the researchers proposed new nutritional reference values that may contribute to more efficient fertilization programs and improved nutrient management in commercial orchards.

Several articles explored the interaction between orchard management practices and plant physiological performance. Studies evaluating grapevine rootstocks and training systems conducted by Domingues Neto et al.(Contribution 6), demonstrated that canopy architecture influences photosynthetic activity, biochemical responses, vegetative growth, and yield components. These findings provide valuable information for adapting viticultural practices to subtropical environments. Climate adaptation through rootstock and cultivar selection was another important topic. Research on 'BRS Núbia' table grapes conducted by Monteiro et al. (Contribution 7) evaluated phenological development and thermal requirements under subtropical conditions, providing information that may assist growers in improving production scheduling and vineyard management.

The diversification of fruit production systems under changing climates was represented by studies on hop cultivation in subtropical Brazil conducted by Sabino et al. (Contribution 8). These investigations demonstrated that high-quality hop cones can be successfully produced under non-traditional growing conditions, creating opportunities for crop diversification and the development of new production regions.

Another publication conducted by Roussos et al. (Contribution 9) investigated the use of mineral particle films in olive orchards exposed to Mediterranean climatic conditions. The application of kaolin-, talc-, and attapulgite-based products reduced heat stress effects and contributed to maintaining fruit productivity and oil quality under challenging environmental conditions.

Finally, the impacts of climate variability on phenology and frost occurrence were investigated in temperate fruit species by Choi et al. (Contribution 10). The study, involving apple and pear orchards, highlighted the challenges associated with changing flowering

periods and frost risks, emphasizing the importance of regional adaptation strategies and climate monitoring tools.

Overall, the articles published in this Special Issue illustrate the multidisciplinary nature of climate adaptation research and demonstrate the importance of combining physiological, agronomic, environmental, and technological approaches to improve orchard resilience.

## 3. Conclusions

The studies included in this Special Issue provide valuable insights into the challenges and opportunities associated with orchard management under climate change. Collectively, the contributions demonstrate that successful adaptation requires integrated strategies involving efficient water and nutrient management, improved cultivar and rootstock selection, optimized canopy architecture, precision agriculture technologies, and climate-informed decision-making.

As climate variability continues to increase, the adoption of innovative and sustainable management practices will become increasingly important for maintaining orchard productivity, fruit quality, and economic viability. The findings presented in this collection contribute to the scientific foundation needed to support the transition toward more resilient fruit production systems worldwide.

The Guest Editors sincerely thank all authors for their valuable contributions, the reviewers for their constructive evaluations and dedication, and the editorial staff of *Horticulturae* for their support throughout the publication process. We hope that this Special Issue stimulates further research and collaboration aimed at developing sustainable orchard systems capable of meeting future climatic challenges.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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