Available online at
http://agrospheresmagazine.vitalbiotech.org/

ISSN (E): 2582 – 7022

Agrospheres:e- Newsletter, (2026) *7*(3), 32-35

Article ID: 921

Climate Change and Its Impact on Fruit Crop Productivity

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Article History
Received: 2. 3.2026
Revised: 6. 3.2026
Accepted: 11. 3.2026

INTRODUCTION

Climate change a worldwide occurrence with intense indication has look right on a central issue in policy-making and environmental studies.In the Indian conditions, climate change is identified by a observable rise in average temperatures, fluctuations in precipitation design and an rise in the regularity of utmost weather events [1]. The key results including temperatures variations, elevated carbon dioxide, drought, salinity, erratic rainfall patterns have substantially influenced plant growth and development by altering various morphological, physiological and factors or human activities that alter the atmosphere or land use, impacting agriculture, horticulture, fisheries, and livestock, and ultimately affecting food security. While climate change itself is not inherently harmful, the resulting consequences can be profound [2].

- Extremes events that are difficult to predict
- More erratic rainfall pattern
- Unpredicted high temperature spell shall affect productivity

Two major parameters of climate changes that have far reaching suggestion on plants are more uncertain rainfall patterns and unforeseeable high temperature spells which are results expected to reduce crop productivity. Drought reduced fruit set and increased fruit cracking in pomegranate and litchi. Temperature increase affects photosynthesis directly, causing alterations in sugars, organic acids, flavonoid contents, firmness, and antioxidant activity. Rise in atmospheric carbon dioxide levels persistently affected post-harvest quality causing sugar content reduction in potatoes and tuber malformation incidence of common scab. An increase in atmospheric temperature and change of rainfall pattern affected the banana cultivation in some countries. In various fruit crops, moisture stress and high temperature during flowering strongly influences the pollen and ovule quality and therefore the fruit set and yield.

TROPICAL	SUBTROPICAL	TEMPERATE
Mango, Banana, Papaya, Pineapple, Sapota, Guava, Jackfruit, Tamarind.	Citrus, Bael, Aonla, Grapes, Pomegranate, Phalsa, Jamun, Mangosteen, Datepalm, Fig, Litchi, Karonda	Strawberry, Plum, Avocado, Pear, Walnut, Peach, Cherry, Apple, Almond

2. CLIMATE CHANGE IN INDIA

India ranked fourth among the countries most affected by climate change in 2015 is experiencing far reaching effects of this worldwide phenomenon. As a country of great importance to the global community, it is crucial to recognize that disruptions within any part of India's land system can have far-reaching implications for the entire ecosystem. With a vast population and remarkable biodiversity, India must remain vigilant in the face of climate change.

3.IMPACTS OF CLIMATE CHANGE ON FRUIT CROPS

It has been shown that high-chilling needed apple cultivars like Royal Delicious have been replaced with low-chilling required cultivars and other fruit crops like peach, kiwi, plum, pear and vegetables. The trend is to switch from the potato and apple cultivation fully in the middle hills of Shimla district. The snowfall pattern and apple production in Himachal Pradesh have been corroborated in this regard. Apple production fell from 10.8 to 5.8 tons per hectare. This is just an example of climate change (Awasthi et al., 2001) [4]

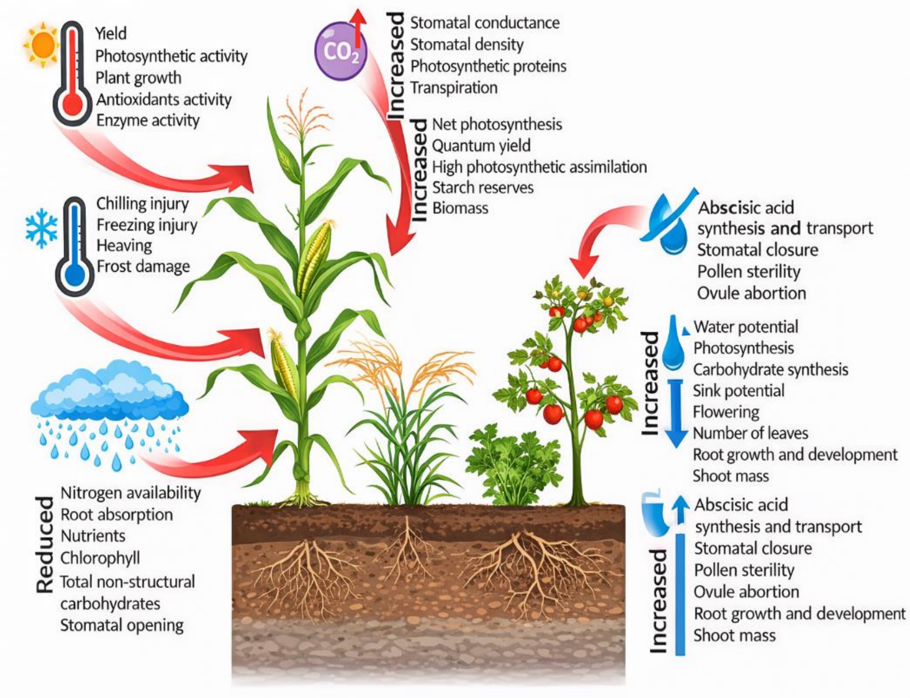

Figure 1. Impact of climate change on crops (B. Subedi et al.)

3.1 IMPACT OF TEMPERATURE

High Temperature- It is a significant environmental factor driven by climate change which have led to increase heat stress that greatly impact fruit crops. High temperature stress refers to an increase in temperature beyond a critical threshold for a duration sufficient to induce unrecoverable damage to plant growth and development (Wahid et al., 2007). In banana trees, temperature of 31-32ºC accelerates the maturity rate, thus reducing the duration required for bunch development. (Turner et al., 2007).

3.2 IMPACT ON PHENOLOGY

As per study conducted by Wolfe et al., there was an advance in spring phenology ranging from 2 to 8 days for the woody perennials in north-eastern USA during period 1965 to 2001 and a qualitatively consistent and similar phenology shifts with a warming trend have been reported for other mid and high latitude regions. An earlier date of full bloom of up to 10 days was observed in apple ‘Boskoop’, ‘Cox’s Orange Pippin’ and ‘Golden Delicious’ when comparing the last 20 years with the previous 30 years, which is less than the 14 days reported generally for Germany.

3.3 IMPACT OF DROUGHT

Water stress disrupts key physiological processes by reducing stomatal conductance, limiting CO_2 assimilation and impairing photosynthetic efficiency, ultimately decreasing plant productivity (Flexas et al., 2006).

3.4 IMPACT OF RAINFALL

In certain areas, because of prolonged and heavy precipitation excessive vegetative growth and flower drop occurs. Mango production in Gujarat declined by 80–90% due to unseasonal rains coupled with severe dew attack, which led to decreased fruit set, increased fruit drop, and a severe outbreak of sooty mould (blackening of mango fruits) and powdery mildew (Rajatiya et al., 2018).

3.5 IMPACT OF CO_2

Global warming is largely driven by elevated carbon dioxide (eCO2) levels accounting for approximately 70% of its effects and it is estimated that by year 2100, CO2 concentration will rise from current 400 ppm to 600–700 ppm. Higher concentration of CO2 in the atmosphere, around the leaf blade reduces stomatal conductance, narrows the stomatal opening and decreases transpiration rate, thus improving water use efficiency. As a result, 11 plant growth and photosynthetic activity are enhanced (Stockle et al., 2009).

3.6 Impact on Fruit Quality

The increase in temperature from 0.7-1.0 °C may shift the area suitable presently for the quality production of Dashehari and Alphonso varieties of mango. Rise in temperature by 0.2 °C may result into dramatic reduction areas suitable for development of red colour on guava (Rajan, 2008) [8].

3.7 Impact on pest and disease incidence

Increase in the number of generation, Extension of developmental seasons, Changes in crop-pest synchrony of phenology, Changes in interspecific interactions of insects and Increased risk of invasion by migrant pests (Parmesan, 2007) [6].

4. Adaptation strategies to overcome the harmful effects of climate change

4.1. Climate-ready crop varieties: Certain fruit crops, such as Dragon fruit, Kair, Phalsa, Pummelo, Beal, Wood apple, Aonla, Karonda, barbarous cherry, and pomegranate, exhibit lower moisture demand and reduced transpiration rates, making them more resilient to temperature fluctuations.

4.2. Monitoring the phenological stages- Monitoring the phenological stages in pome, nut and stone fruit crops in response to environmental and climatic shifts and formulating suitable management practices. Rising winter temperatures due to climate change can disrupt the chilling requirements of apple, cherry, walnut, peaches, etc. which are crucial for healthy bud formation.

4.3 Selection of resistant varieties/rootstocks against abiotic and biotic stresses

Choosing suitable fruit crop varieties is crucial for enhancing resilience to abiotic stresses like drought, extreme temperatures and soil salinity as well as biotic challenges such as pests and diseases.

- Example -Almond Variety GF677 is Salinity tolerant
- Grapes Rootstock Dogridge and Salt Creek B2/56,110R is Drought and Salinity tolerant
- Pomegranate Variety Punica granatum var. Ruby is Drought tolerant
- Sapota Rootstock Khirni is Drought tolerant

(Source- Singh et al. 2009; Singh 2010; Pathak and Pathak, 1991; Bose et al., 2001)

4.4 Adopting innovative agricultural practices and efficient resource-saving technologies

Mango fruits enclosed in brown paper and a scurting bag at the marble stage showed the highest retention rate, whereas those wrapped in newspaper bags achieved the greatest weight and remained unaffected by spongy tissue (Haldankar et al., 2015).

ISSN (E): 2582 – 7022

5. Future strategies that need to be addressed

- Measuring the effects of temperature fluctuations, as well as excessive or insufficient moisture, is a crucial step in helping fruit industry for creating adaptation strategies for future climate scenarios. Detailed study on how individual fruit crops are impacted in key agro-ecological regions and growing seasons should be done.
- Identification and development of heat, water and climate-tolerant crops and varieties for various agroecological regions and growing seasons.
- Planting of dense and tall growing windbreaks during orchard establishment to shelter pollinating insects, protect the orchard from wind erosion, and mitigate the impact of natural disasters.
- Environmentally-friendly chemicals should be generated to break the dormancy period.

CONCLUSION

Climate change is an undeniable reality, with substantial evidence linking greenhouse gas emissions (GHGs) to global warming and climate shifts. With the continuous rise in global temperatures, unpredictable rainfall patterns, drought, salinity, elevated CO2 levels and ongoing land degradation, it is crucial to comprehend the impact of climate change on fruit tree physiology. Climate change also leads to changes in suitable areas for fruit production, resulting in inadequate chilling hours and affecting dormancy breaking and yield in temperate fruits like apples. Loss in plant diversity and area suitability due to climate change will further increase the problem. As global warming is considered inevitable, endeavour should thus be undertaken to manipulate the chilling requirements of the temperate fruit crops by various means.

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