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The Bloom before the Bite: How Climate Change is Affecting Litchi Flowering and Fruit Set

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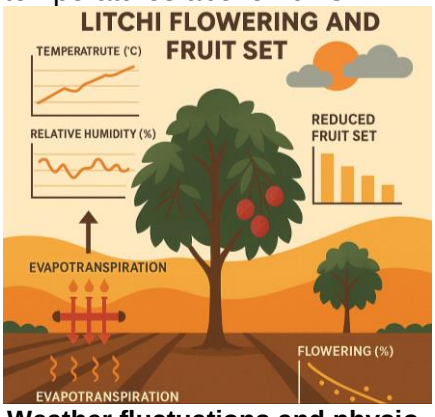
Litchi (*Litchi chinensis* Sonn.), known as the "Queen of Subtropical Fruits," is mostly grown in northern and eastern India, especially in Bihar, West Bengal, and Jharkhand. The temperature and humidity have a direct effect on when it blooms and when it sets fruit. Climate change can cause small changes in these traits that can have a big effect on phenological processes and lower fruit production. Research from the ICAR-National Research Centre on Litchi in Muzaffarpur, Bihar, shows that changes in temperature at important times, like when the panicle is growing and when it is flowering, can cause fruit loss and flowers to grow wrong. For instance, a recent study found that extended cloud cover during full bloom inhibits fruit set and cross-pollination, but heat waves and hot winds in April and May are directly linked to higher fruit drop and lower quality (Kumar, 2014). Litchi depend on accumulated heat units within a limited range (minimum winter temperatures of about 10°C and diurnal variation of up to 25–35°C) to control flowering and fruiting, according to research conducted in the Sub-Himalayan Terai region of West Bengal. Unpredictable bloom patterns and uneven production result from departures from this range (Bhowmick & Subba, 2022).

Increased nutritional deficiency and mite infestation on litchi plants under high temperature and changed precipitation trend

Furthermore, a 2024 study in the Indian Tarai that used regression analysis discovered that while rainfall and humidity had positive correlations with litchi yield, high maximum temperatures had a strong negative correlation ($r = -0.84$, $p < 0.01$) (Lal et al., 2024). When taken as a whole, these results present a troubling picture: litchi phenology and fruit production are being stressed by increasing heat stress, unpredictable rainfall, and changing seasonal patterns—all of which are signs of climate change.

The Sensitive Bloom Cycle

Accurate temperature cues are essential for the growth of litchi (*Litchi chinensis*). For flower production, low winter temperatures of about 15°C during the day and 10°C at night are essential. According to research, flowering is best triggered by four to six weeks of exposure to ~15°C, although prolonged warmer or cooler temperatures interfere with this process (Lu et al., 2022). Bloom rates are significantly decreased by induction temperatures above 20 °C.



Weather fluctuations and physiological impact on litchi orchards

When Winters Get Too Warm

These once-predictable patterns are changing due to climate

change. In India's litchi belts, winters now frequently last longer than is optimum. Average temperatures during the 2018–19 winter were 17.8°C, which is below optimal chill levels. As a result, flowering and yields in subtropical orchards were noticeably poor. According to a 2025 study conducted in Himachal Pradesh on the 'Dehradun' cultivar, cooler Decembers promoted higher fruit set, while warmer Decembers were associated with excessive vegetative growth—at the expense of flower development (Shivandu et al., 2025).

Erratic Rainfall and Pollination Problems

Reproductive success is further disrupted by unpredictable weather. Persistent cloud cover or unseasonable rain during bloom can hinder pollination, lower pollen viability, and cause fungal infections that can destroy nascent blooms. Additionally, dry spells during fruiting and heat waves in March–April weaken floral clusters and increase fruit and blossom drop (Menzel & Simpson, 1995).

Pollinators under Stress

Apis cerana bees are essential to the pollination of litchi. However, pollinator activity is declining due to environmental changes and rising temperatures, which results in fewer visits and less fruit set. This pattern is consistent with how larger ecosystems are adapting to climate change.

Facing the Genetic Bottleneck

Commercial litchi orchards in India frequently depend on a limited genetic background, especially cultivars like "Shahi," "Bombai," and "Dehradun." Despite being consistent, they are not resistant to changes in temperature (Bajpai et al., 2016). In an attempt to increase climate adaptation, efforts are being made to investigate wild cousins or local landraces that show staggered flowering or decreased chilling requirements.

Adaptive Tactics by Farmers

Water management, irrigation during bloom and fruit set to reduce heat and moisture stress, the use of plant growth regulators, and agroforestry with sunflower or mustard to draw pollinators are some of the ways farmers are adjusting. There are a number of clever, inexpensive ways that farmers can help litchi orchards adapt to climate change. Risk can be decreased by using heat-tolerant, early-flowering cultivars like Shahi or Gandak. Drip irrigation and mulching help control temperature and preserve soil moisture. Simple devices that shield flowers from heat and sunburn include shade nets, foggers, and kaolin sprays. Gibberellins aid in fruit retention, and paclobutrazol (PBZ) sprays in the winter can encourage consistent flowering (S. K. Singh et al., 2019). Microclimate is improved by managing orchard layout with windbreaks, intercrops, and appropriate pruning. Most significantly, bee box installation increases pollination, and farmers can utilize smartphone apps like "Meghdoot" to receive crop advisories and weather notifications. When combined, these doable actions can increase the resilience and profitability of litchi farming in the face of climate change.

Charting a Resilient Path

We must take numerous steps to protect litchi's future:

- Integrate genes from climate-adapted landraces and wild relatives for breeding resilient cultivars.
- Climate-smart zoning: Adjust growing areas according to regional temperature patterns.
- Agro-technological tools: Utilize early-warning systems for rainfall and temperature during critical times.
- Supportive policy: Under programs like NICRA, offer insurance, micro-irrigation subsidies, and access to growth regulators.

The Bloom Must Go On

The destiny of litchi blossoming pulses in both marketplaces and fields. It is not only wise, but essential to comprehend climate triggers and equip farmers with science-based instruments. Each summer may continue to reveal those exquisite litchis thanks to climate legislation, wise agricultural practices, and robust varieties—evidence that sweet success is still achievable despite growing climate problems.

Conclusion

A perennial subtropical fruit crop, litchi is especially susceptible to the changing patterns of climate change. Flowering, fruit set, and fruit quality are all directly impacted by rising temperatures, unpredictable rainfall, unseasonal storms, and protracted droughts. While irregular winter chilling disrupts panicle initiation, which significantly reduces yields, heat stress frequently results in flower and fruit drop. Furthermore, litchi plants are more vulnerable to pest and disease outbreaks due to climate-induced stressors, which increase growers' losses. The productivity of litchi orchards as well as the stability of the livelihoods of farmers who rely significantly on this valuable crop is at risk due to these issues. To protect litchi cultivation in the age of climate uncertainty, adaptation techniques like integrated orchard management, irrigation scheduling, varietal improvement for heat and drought tolerance, and microclimate management are essential. In order to ensure the resilience of fruit-based farming systems, it is imperative that the effects of climate change on litchi be addressed. This goes beyond the issue of production.

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