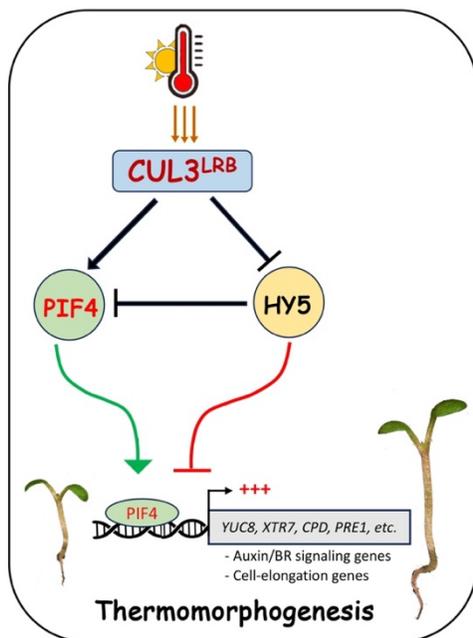


Novel Discovery: Key Proteins Help Plants Adapt to Warmer Climates, Paving the Way for Climate-Resilient Crops

Scientists at the Indian Institute of Science Education and Research (IISER) Kolkata, in collaboration with Jawaharlal Nehru University (JNU), New Delhi, have uncovered a key molecular mechanism that helps plants sense and respond to warmer temperatures, a discovery with significant implications for developing climate-resilient crops. Published in *Science Advances*, the study reveals that LIGHT-RESPONSE BRIC-A-BRACK/TRAMTRACK/BROAD (LRB) E3-ubiquitin ligases play an essential role in thermomorphogenesis, the process by which plants elongate their stems in response to warmer temperatures, in the model plant *Arabidopsis thaliana*.

Rising global temperatures pose a major threat to agriculture, impairing plant health and reducing crop productivity. When exposed to warmer conditions (e.g., a shift from 22°C to 27°C), plants undergo thermomorphogenesis, an adaptive stem elongation driven by increased production of growth hormones such as auxin and brassinosteroids. Understanding the molecular switches governing this response is critical to engineering crops that can thrive under climate change. This study reveals that LRBs act as critical switches in this process via a sophisticated dual mechanism that targets two key transcription factors. On one hand, LRBs stabilize PHYTOCHROME INTERACTING FACTOR4 (PIF4), a central promoter of warm-temperature growth. By physically associating with PIF4, LRBs protect it from degradation, ensuring sufficient protein levels to activate genes involved in hormone biosynthesis and downstream growth responses. Concurrently, LRBs ubiquitinate and degrade ELONGATED HYPOCOTYL5 (HY5), a major repressor of thermomorphogenesis. HY5 inhibits PIF4 activity by competing for binding sites on growth-related gene promoters. By reducing HY5, LRBs relieve this inhibition, allowing PIF4 to drive robust warm-temperature growth. First author Dr. Chirag Singhal noted that the team employed genomic, genetic, and biochemical tools to uncover LRBs' upstream regulatory role, enhancing PIF4 function while suppressing the light-responsive pathway mediated by HY5. "This dual regulation allows plants to fine-tune their response to temperature cues," he explained.



Lead researcher Dr. Sreeramaiah N. Gangappa (Associate Professor, IISER Kolkata) added, "Our findings highlight LRBs as novel master regulators in the thermosensory pathway. By differentially controlling PIF4 and HY5 stability, LRBs enable plants to prioritize elongation growth under warmer conditions, overriding photomorphogenic restraint." The discovery builds on prior knowledge of LRBs in light signaling but reveals a distinct, activating role in temperature response. Crucially, because LRBs are conserved across plant species, including crops, these findings open new targets for genetic engineering to generate climate-resilient crops that sustain agricultural productivity under rising temperatures.

The research was conducted at IISER Kolkata in collaboration with Prof. Mukesh Jain (School of Computational and Integrative Sciences, JNU, New Delhi). It was funded by the Anusandhan National Research Foundation (ANRF), the Department of Biotechnology (DBT), Government of India, and internal funding from IISER Kolkata.

For more details, refer to the article "Singhal C, Upadhyaya G, Rajkumar MS, Modak A, Sethi V, Singh S, Das D, Jain M, Gangappa SN. *CUL3^{LRB} E3 ubiquitin ligases control thermosensory growth in Arabidopsis by differentially regulating HY5 and PIF4 protein stability.* *Sci. Adv.* **12**, eac7817(2026). DOI: [10.1126/sciadv.aec7817](https://doi.org/10.1126/sciadv.aec7817)