



# CRISPR Technology for Climate-Resilient Crops

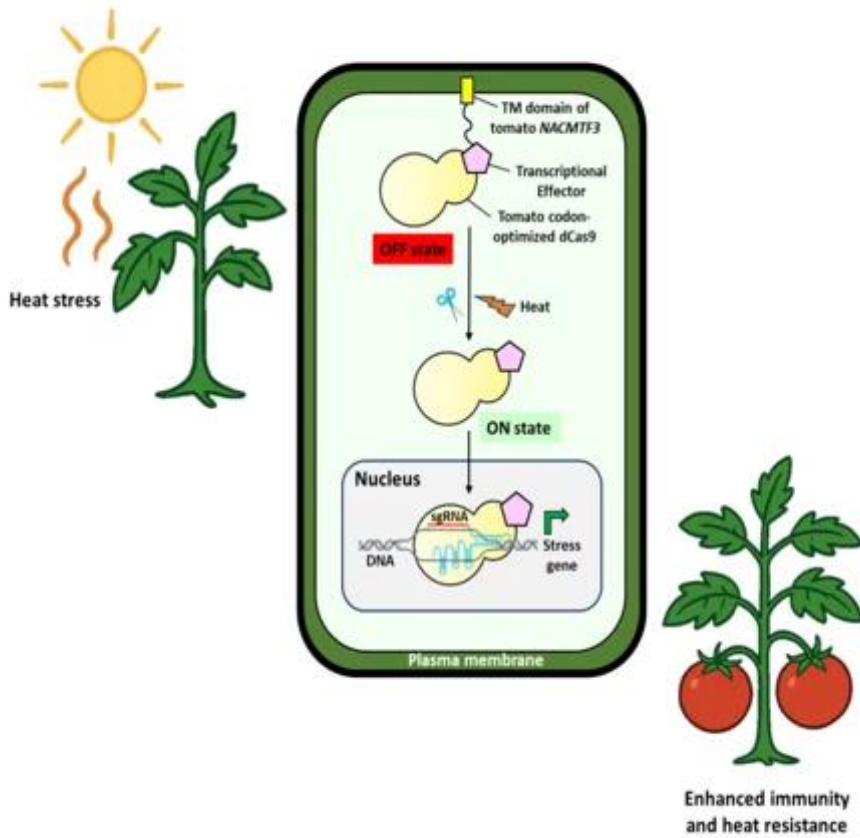
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Scientists from the **Bose Institute**, under the **Department of Science and Technology (DST)**, have developed a **novel CR-9ISPR-dCas9-based molecular tool** that **enhances plant resistance to heat stress and pathogen attacks**.

## CRISPR-dCas9-Based Molecular Tool

- **CRISPR-dCas9:** It is a **modified version of the CRISPR-Cas9 gene-editing tool**. In this version, the **Cas9 protein is made inactive**, meaning it can **no longer cut DNA**. However, it still uses a **guide RNA (gRNA)** to find and attach to specific **DNA** sequences.
  - While regular CRISPR-Cas9 works by cutting DNA to make changes in the gene, **CRISPR-dCas9 does not cut the DNA**. Instead, it **acts like a gene switch** by **turning specific genes on or off without changing the DNA itself**.
  - This makes it **useful for safely controlling** when certain genes, like **stress-response genes** in plants, are activated, only when needed, **saving energy and improving efficiency**.
    - **CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats)** is a **gene-editing technology** that uses the **Cas9 protein** and a **guide RNA (gRNA)** to act as **genetic scissors**, enabling precise **cutting, removal, addition, or alteration** of DNA sequences in living organisms.
- **Working Mechanism:** Plants often **face stress due to extreme weather or pathogen attacks**, which **reduces their productivity and growth**.
  - **CRISPR-dCas9** helps plants **respond only when under stress** using a **transmembrane (TM) domain from a tomato protein (NACMTF3)** to keep a modified protein, **dCas9**, **outside the nucleus under normal conditions**.
  - During stress (like **heat** or **pathogen attack**), the TM domain **releases dCas9**, which then enters the **nucleus** and activates specific **defense genes**.
    - **Under pathogen attack (e.g., *Pseudomonas syringae*)**, it activates **CBP60g** and **SARD1** **immune response genes**, boosting immune responses, **and under heat stress**, it activates **NAC2** and **HSFA6b**, improving **water retention, leaf greenness, and thermotolerance**.
- **Application:** Tested on **tomato, potato, and tobacco**, it showed the **highest effectiveness in tomato plants**.

### A Smart Tool to Help Plants Tackle Heat and Infections Under Heat Stress



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