

Gene-based model predicts when Japan's cherry buds awake from dormancy

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Cherry blossoms of Somei Yoshino at Ito Campus, Kyushu University. Credit: Atsuko Miyawaki-Kuwakado, Kyushu University

Japan in spring is famous for its cherry blossoms, or sakura, which begin flowering in the southern region of Kyushu and blaze upwards to the

remote north of Hokkaido. The most abundant cherry tree cultivar, Somei Yoshino, is the iconic symbol of spring, as the cloned trees flower simultaneously at each site, creating a fleeting explosion of white-pink blossom that enraptures locals and tourists alike.

The flowering forecasts of Somei Yoshino are poured over for months before flowering, as visitors plan their trips and locals organize festivals and celebrations. However, due to climate change, the flowering times of these [cherry trees](#) are shifting and becoming harder to predict.

Now, researchers from Kyushu University and the Forestry and Forest Products Research Institute have developed a model that uses [gene activity](#) to predict when Somei Yoshino cherry tree buds awake from dormancy.

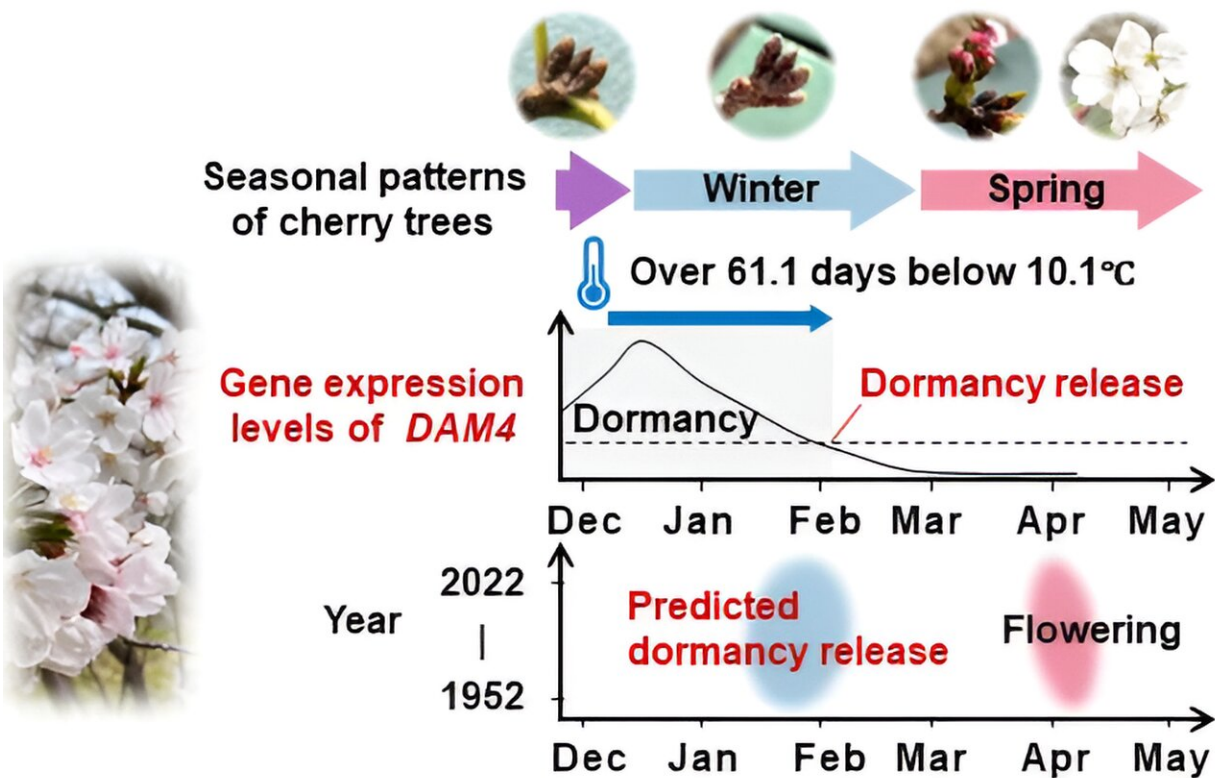
Their findings, published September 19 in the journal [Plants, People, Planet](#), could not only help improve the accuracy of flowering forecasts, but also highlight the potential of climate change to threaten flowering in Japan's southern region.

Before cherry trees can flower, the buds must pass through two dormancy phases, endodormancy and ecodormancy. A period of sufficiently cool temperatures over winter is needed to break endodormancy, while transitioning out of ecodormancy requires an input of heat in spring.

"This need for both cooling and heating means that flowering times can be very unpredictable," explains first author, Atsuko Miyawaki-Kuwakado, a JSPS Research Fellow (PD) from Kyushu University's Faculty of Science. "Depending on the temperature of autumn, winter, and spring, flowering could be early, delayed, or hindered altogether."

When ecodormancy breaks, the buds quickly start to grow and open. But

knowing when the previous stage of endodormancy has broken is tricky, as the buds show no noticeable change. However, Miyawaki-Kuwakado and senior author, Professor Akiko Satake of Kyushu University's Faculty of Science, hypothesized that studying the inner workings of the bud could reveal the timing of this key moment.



Expression levels of *DAM4* decrease throughout winter with each day below 10.1°C. After around 61 days, *DAM4* activity is low enough for endodormancy to break. Credit: Atsuko Miyawaki-Kuwakado, Kyushu University

From October onwards, the researchers took leaf and bud samples each month from Yoshino cherry trees located at three sites across Japan:

Fukuoka in the south, Tsukuba in the center and Hokkaido in the north, capturing a snapshot of what genes were most active at each point in time.

The researchers found that buds of Yoshino cherry trees generally passed through five main gene activity patterns, in early summer, summer, autumn, winter and spring, with each activity pattern correlating closely with temperature.

The research team then focused on the activity, or [expression levels](#), of a subset of genes, called DAM, which are associated with bud dormancy. Out of the six DAM genes, the researchers found that DAM4 activity played a key role in maintaining endodormancy.

"We saw that at the start of winter, DAM4 was highly expressed, but as each day passed with temperatures below 10.1°C, the activity of DAM4 decreased. Once below a certain threshold, the buds awoke from dormancy and flowered when experimentally heated," says Satake.

Using a model based on the activity of DAM4, the researchers concluded that Yoshino cherry trees require around 61 days with temperatures lower than 10.1°C for endodormancy to break. From historical temperature data by the Japan Meteorological Agency, the team then estimated that from 1990–2020, the breaking of endodormancy was delayed by 2.3 days per decade.

Moving forward, forecasters could use the estimated awakening times to improve their predictions of when the Yoshino cherry buds will flower. The researchers also plan to refine the model to predict how climate change could impact flowering.

"Without sufficient cool days over winter, endodormancy cannot break and Yoshino buds cannot flower," says Miyawaki-Kuwakado.

"Therefore, it's important to predict the impact of global warming, particularly in Japan's southern region, so that we can try to develop strategies to mitigate it."

More information: Impacts of climate change on the transcriptional dynamics and timing of bud dormancy release in Yoshino-cherry tree, *Plants, People, Planet* (2024). [DOI: 10.1002/ppp3.10548](https://doi.org/10.1002/ppp3.10548)

Provided by Kyushu University

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