

| ACHIEVEMENTS

NTU Researchers Collaborate with Japanese Counterparts to Unveil The Origin of The Adzuki Bean and Agriculture in Japan

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Photo: Yu Takahashi

| Wild adzuki beans (left) and cultivated adzuki beans (right) show how domestication has altered seed coat color and seed size. Photo courtesy of Yu Takahashi.

When and where did the adzuki bean start to be transformed from wild plants into the types we consume today? When and where did early agriculture originate in Japan? Could these archaeological questions be answered by taking a genetics approach? Led by Prof. Cheng-Ruei Lee of the Institute of Ecology and Evolutionary Biology, National Taiwan University (NTU), an international team has confirmed that cultivated adzuki originated in Japan and that Japan's early agriculture existed thousands of years earlier than previously thought. These results were recently published in the journal *Science*.

Supported by the "Columbus Program" and "International Outstanding Young Scholars Program" of the National Science and Technology Council (NSTC), Prof. Cheng-Ruei Lee initiated an international team with Dr. Ken Naito of the National Agriculture and Food Research Organization (NARO), Japan. With the postdoctoral researcher Dr. Chih-Cheng Chien and other colleagues, the team investigated adzuki bean germplasms conserved in the NARO gene bank. The investigation of this plant's genetics not only answered the long-standing archaeological questions but also pioneered novel directions for crop breeding.

The mainstream view has been that the early inhabitants of Japan, the Jōmon people, relied on hunting, gathering, and fishing for food. Japan's agriculture was thought to have originated when the Yayoi people, who migrated into Kyushu from continental Northeast Asia about three thousand years ago, introduced rice farming, which later spread across Japan. While recent archaeological research suggested the Jōmon might have engaged in plant selection or management, direct evidence was lacking.

Through their painstaking analysis of adzuki germplasm genetic variations across Asia, the team found that wild adzuki was genetically transformed into the cultivated forms of today three to five thousand years ago. This discovery suggests that the Jōmon were not merely hunter-gatherer-fishers; they had primitive agricultural knowledge and the ability to select plants. The results provide direct evidence from plant genetics to answer this long-standing question in archaeology.

In most legume crops, wild forms have smaller seeds with black seed coats. Cultivated forms, on the other hand, have larger seeds with more diverse colors. Ancient crop seeds

were difficult to preserve in the humid climate of East Asia. Therefore, archaeological research primarily relies on carbonized seeds charred by fire or seed impressions in pottery or pottery shards, making it difficult to trace the timing of seed coat color change.

The team identified genes controlling the adzuki seed coat color change and other domestication traits. The changes in these genes occurred nearly ten thousand years ago, suggesting the Jōmon engaged in the selection and management of adzuki beans much earlier than previously thought.

This research provides direct evidence for answering the long-standing question in archaeology and underscores that genetics could help resolve long-standing questions in other fields, offering novel research directions.



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