

## Pawpaw (*Asimina triloba*) Floral Differentiation Period in Miyazaki Prefecture, Japan

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### Summary

Pawpaw (*Asimina triloba*) is a North American fruit crop with potential in as a novel crop in Japan. This paper describes the

flowering phenology of pawpaw under local conditions in Miyazaki Prefecture.

### INTRODUCTION

Pawpaw (*Asimina triloba* (L.) Dunal) is a temperate fruit tree and can be cultivated over a wide area in Japan. The flower bud differentiation period of the pawpaw in Japan was in mid-May for plants cultivated in Osaka and Kyoto Prefectures (Hirai, 1954; Sobajima, 1955). With global warming, the flower bud differentiation period may differ

depending on the cultivation area. Therefore, this study investigated the flower bud differentiation period of pawpaw grown in Miyazaki Prefecture, located south of the Kinki region, Japan.

### MATERIALS AND METHODS

One 11-year-old grafted pawpaw and one 15-year-old grafted pawpaw, 'Rebecca

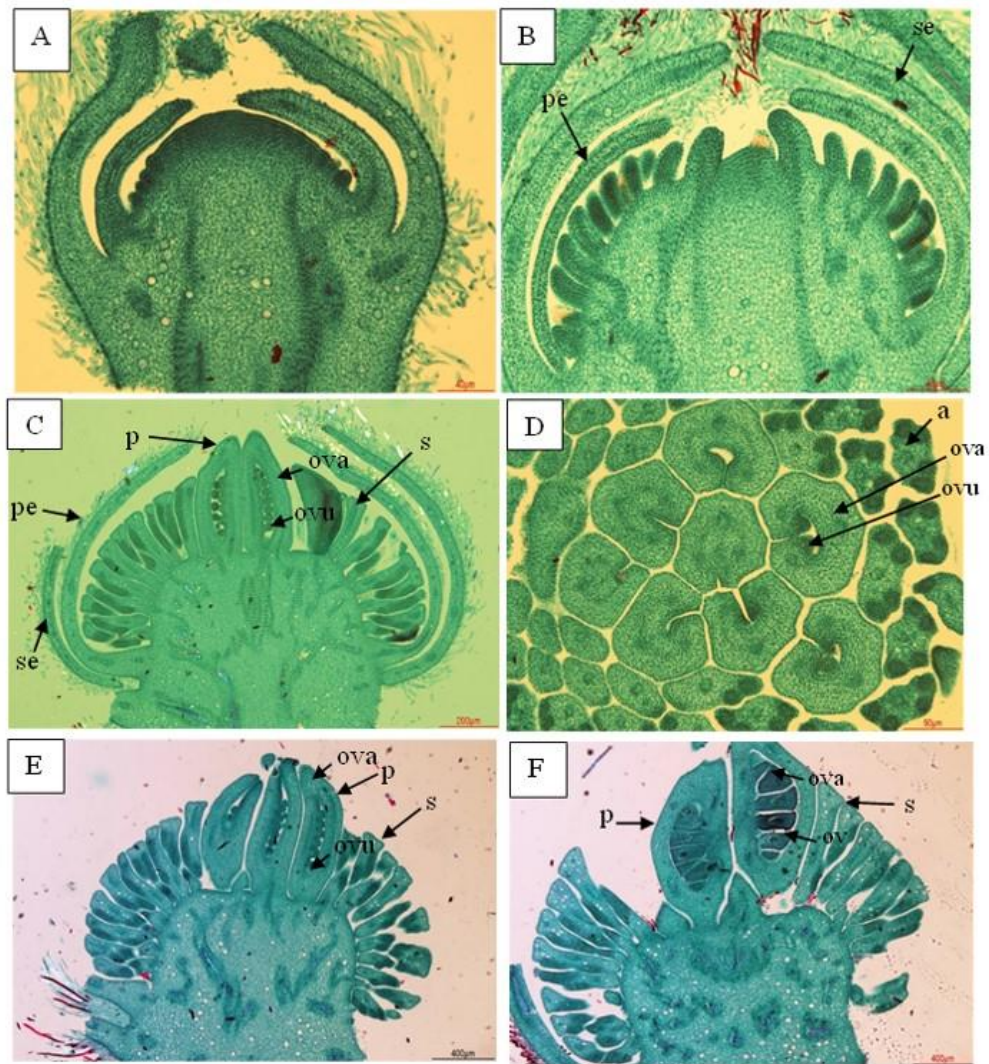
Gold', grown outdoors in Nichinan, Miyazaki Prefecture, Japan, were studied. Survey materials were collected on June 8, July 9, August 7, September 4, October 4, November 1, and December 1, 2017, January 5, February 8, and March 8, 2018, and May 16, May 28, and June 14, 2021. Each time, we selected three ca. 15-cm non-fruit-bearing branches grown in the current year at a near-horizontal angle. Five buds were collected randomly from each branch, each time, and immediately fixed in formalin acetic acid alcohol solution (50% ethanol : formaldehyde solution : acetic acid = 90 : 5 : 5). Pawpaw flower buds are covered with a hard brown outer skin, so after removing the outer skin, the flower buds were observed using a stereomicroscope. Some of the buds were sectioned longitudinally to a thickness of 15  $\mu\text{m}$  using paraffin sectioning, and double-stained with Safranin O and Fast green. Under an optical microscope, we made morphological observations of flower bud differentiation.

## RESULTS AND DISCUSSION

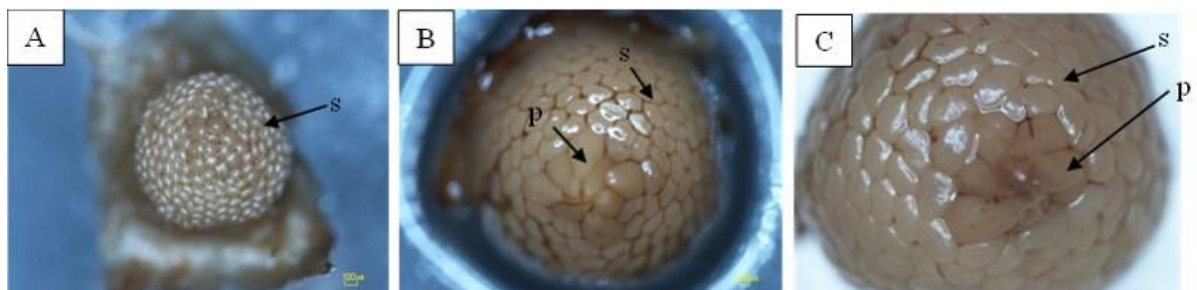
The flower buds on May 16, 2021 were in the early stages of differentiation, with the shoot apex thickening and beginning to change into a flat or dome-like shape (**Fig. 1A**). In the bud on May 28, 2021, the primordia of sepals, petals, and stamens were observed (**Fig. 1B**). In the buds on June 14, 2021, pistil primordia formation, and ovules, ovaries, and anthers were also observed (**Fig. 1C, D**). Many stamens were also seen in the buds observed under a stereomicroscope on June 8, 2017. These results confirmed that stamen primordia had

already formed in late May. As shown in Figure 1, the pistil continued to develop until September, and the transverse diameter of the pistil on September 4, 2017, was 549.2  $\mu\text{m}$ . No significant differences were observed in the development of flower buds from October until February of the following year (data omitted). However, in March 2018, one month before flowering, the flower buds enlarged rapidly, and the horizontal diameter of the flower buds was 5,048.4  $\mu\text{m}$  (**Fig. 2C**). According to Miyahara et al. (2018), pawpaw trees enter a dormant period in mid-October and awaken from dormancy in early March, so it is thought that flower bud development may have stopped during that time.

Based on these results, the flower bud differentiation period of pawpaw in Miyazaki Prefecture, Japan, is in mid-May. The results were similar to those obtained by Hirai (1954) and Sobajima (1955) when they investigated pawpaw trees grown in Osaka and Kyoto Prefectures 68 to 69 years ago. Recently, global warming has progressed. Osaka/Kyoto Prefectures and Miyazaki Prefectures are at different latitudes, with Miyazaki Prefecture located far to the south; nevertheless, the flower bud differentiation period was similar. For many deciduous fruit trees, flower bud differentiation occurs from June to August, but for pawpaw, it occurs much earlier, in mid-May.



**Figure 1.** Observations of the flower bud formation process of pawpaw using an optical microscope. Collection dates: A) 2021.5.16, B) 2021.5.28, C D) 2021.6.14, E) 2017.8.9, and F) 2017.9.4 (A, B, C, E, and F: longitudinal sections, D: cross-section) s, stamen; p, pistil; pe, petal; se, sepal; ovu, ovule; ova, ovary; a, anther.



**Figure 2.** Stereomicroscope observations of pawpaw flower bud formation. Collection dates: A) 2017.6.8, B) 2017.7.9, and C) 2018.3.8. s, stamen; p, pistil.