

Low night temperature inhibits fertilization and consequently reduces fruit set in ‘Monthong’ durian

Durian flowers mainly in January in Chanthaburi, the main production area in Thailand. Chanthaburi’s average minimum temperature for January is 20.7°C (10-year average); however, in 2014, the daily minimum temperature dropped to lower than 15°C for the first time in five years, with record-low temperatures (below 17 °C) lasting about a week. Usually, durian trees set fruits at 15-30%; however, the fruit set was quite poor that year especially for ‘Monthong’, the leading cultivar in Thailand. Empirical observations have shown that ‘low temperature’ during anthesis reduces fruit set, but the effect of low temperatures on the development of fruit set in durian is not fully understood because the trees grow very high in the fields where environmental factors, such as temperature, are difficult to control.

In this study, we developed a temperature controller that can be used in the orchard, and we examined the effect of night temperature on fruit set. Morphological development of ovules was also observed and its influence on fruit set was evaluated.

A polystyrene foam box equipped with Peltier devices was attached to a bearing branch to enclose one cluster (Fig. 1). The temperature inside the box was fixed at 15°C or 25°C during nighttime (2000 to 0800h) for 7 days after pollination (DAP). The box was detached after the 7th day. At 25°C, about 30% of the flowers set fruits at 28 DAP, whereas all flowers abscised by 21 DAP at 15°C (Fig. 2). Pollen tubes elongated within the styles in both 15°C and 25°C. However, at 15°C, 14.7% of ovules remained at the mature stage (Fig. 3A, Table1), which is the normal stage before accepting pollen-tube nucleus. No mature ovules were found at 25°C. Endosperm nuclei are the result of fertilization; therefore, it was considered that fertilization occurred at 25°C but did not occur at 15°C. The average length of the ovule at 15°C was considerably shorter than the one at 25°C (Table 1).

These findings suggest that night temperature of 15°C inhibits fertilization and consequently causes poor fruit set in ‘Monthong’ durian. ‘Monthong’ is the most important cultivar in Thailand; however, the fruit set is easily affected by night temperatures. To avoid risk caused by low temperature, planting other cultivars besides ‘Monthong’ or applying plant growth regulators to extend the flowering period is recommended. Adaptation of other cultivars that set fruits at low temperature conditions is also an effectual way for the stable production of durian. In this regard, the temperature controller we have developed can be a useful tool for examining cultivars that set fruit even at low-temperature conditions.

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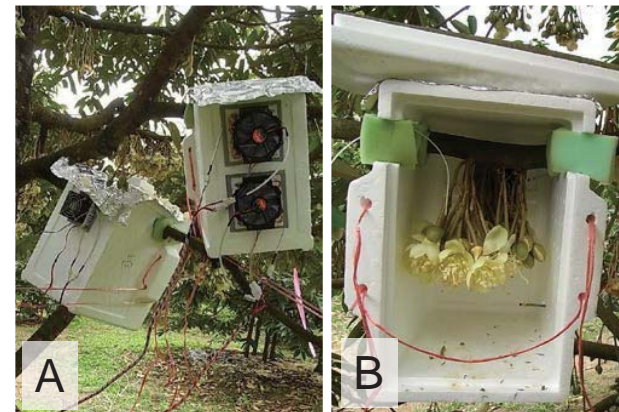


Fig. 1. Temperature controller set on a flower cluster. A: A polystyrene foam box equipped with Peltier devices was used as controller. B: Inside the controller (The lid was left open during daytime).

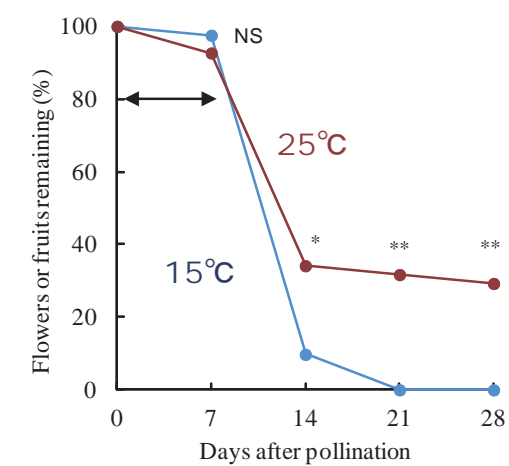


Fig. 2. Percentages of flowers or fruits remaining after pollination. Asterisks (* and **) indicate significant differences between the treatments based on Fisher’s exact test at $P<0.05$ and $P<0.01$, respectively. NS indicates a non-significant difference. Arrow shows the duration of temperature treatment.

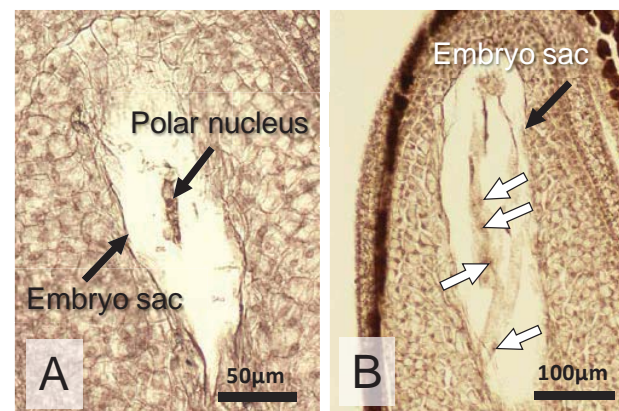


Fig. 3. Micrographs showing the morphological development of ovules at 7 days after pollination (DAP). A: Ovule at the mature stage containing an embryo sac with a fused polar nucleus (15°C). B: Ovule at the endosperm nuclei division stage (25°C). White arrows indicate endosperm nuclei.

Table 1. Average length of the ovules and the developmental stages at 7 DAP

Treatment	Number of ovules observed	Length of ovules (mm)	Stages of ovule development (%)			
			Mature	Endosperm nuclei division	Deformed	Degenerated
15 °C	21	1.19	14.3	0	66.7	19.0
25 °C	22	1.48	0	22.7	45.5	31.8