



MALAY APPLE (*Syzygium malaccense*) FRUIT CALENDAR: A CASE IN CENTRAL JAVA

KALENDER BUAH JAMBU BOL (*Syzygium malaccense*): KASUS DI JAWA TENGAH

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Abstract

Malay apple (*Syzygium malaccense*) is a kind of popular fruit tree originally from Indo-Malayan-Region or South East Asia. There are many environmental factors affecting the flowering time, infructescence number, fruit size, and fruit number, such as fruit position on the spur, spur size, fruit number set on the spur, and the date of flowering. The objectives of this study were to find out the fruit production during dry and wet seasons, so that fruit calendar can be determined. The method used in this study was survey and observation on Malay apple trees in Banyumas, Purbalingga, and Kebumen from 2018 to 2021. The results of this study showed that June, July, and August when the precipitation was the lowest, the fruit number is the highest, and fruit size is the smallest (145–175 mL). On the other hand, when the precipitation was high (September-April), the fruit was the largest (180–500 mL). Fruit harvest time might change every year depending on climatic factors such as average daily temperature and precipitation. There is no specific harvest time for Malay apples. The implementation of the results of this research is that we do not need to predict when the Malay apple harvest season will be, because the harvest time can be at any time.

Keywords: Fruit number; Harvest time; Malay Apple; Size

Abstrak

Jambu bol (*Syzygium malaccense*) merupakan salah satu jenis pohon buah-buahan populer yang berasal dari Wilayah Indo-Malayan atau Asia Tenggara. Banyak faktor lingkungan yang memengaruhi waktu berbunga, jumlah bunga, ukuran buah, dan jumlah buah, seperti posisi buah pada tajuk, ukuran tajuk, jumlah buah tiap dompol, dan tanggal berbunga. Penelitian ini bertujuan untuk mengetahui produksi buah pada musim kemarau dan musim hujan, sehingga dapat ditentukan kalender buah. Metode yang digunakan dalam penelitian ini adalah survei dan observasi pada pohon jambu bol di Banyumas, Purbalingga, dan Kebumen dari tahun 2018 sampai dengan tahun 2021. Hasil penelitian ini menunjukkan bahwa pada bulan Juni, Juli, dan Agustus curah hujan paling rendah, jumlah buahnya paling tinggi, dan ukuran atau volume buahnya relatif paling kecil (145–175 mL). Sebaliknya, ketika curah hujan rata-rata tinggi (September-April), buahnya berukuran besar, dengan volume 180–500 mL. Waktu panen buah dapat berubah setiap tahun tergantung pada faktor iklim seperti suhu harian rata-rata dan curah hujan. Hasil penelitian ini menunjukkan bahwa tidak ada waktu yang spesifik untuk waktu panen jambu bol. Implementasi dari hasil penelitian ini adalah bahwa kita tidak perlu memprediksi kapan musim panen jambu bol, karena waktu panen bisa kapan saja.

Kata Kunci: Jambu bol; Jumlah buah; Musim panen; Ukuran

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INTRODUCTION

Malay apple [*Syzygium malaccense* (L.) Merr. & L.M.Perry] is a species of flowering tree native to Malesia though now widely cultivated throughout Indonesia (Mead, 2013). It has been introduced throughout the tropics, including many Caribbean countries and territories such as Jamaica where it is known simply as Jamaican apple or the more common Otaheite apple (Fernandes & Rodrigues, 2018). It has been spread by humans through much of Southeast Asia and the Pacific Islands. Now common growing wild on the Hawaiian Islands. The Malay apple was an important fruit of the Polynesians (Whistler & Elevitch, 2006; Global Invasive Species Database, 2009).

The tree with its dense conical or columnar canopy with dark green foliage; broadly ovoid canopy (Global Invasive Species Database, 2009). Flowers which are deep pink is considered to the most beautiful flower amongst *Syzygium*. The fruits which are large oblong-shaped, the color ranges from white, pink, red, dark red to blackish (Morton, 1987). The fruit is the flesh is white and surrounds a large seed. Its taste is bland but refreshing, and sometimes is sweet in some varieties. The fruits can be made into jam and is prepared by stewing the flesh with brown sugar and ginger.

Malay apple is a strictly tropical tree and will be damaged by freezing temperatures in non tropical areas (Jones, 1981). It thrives in humid climates with an annual rainfall of 1,520 mm or more. It can grow at a variety of altitudes, but normally they are cultivated from sea level up to 700 m a.s.l. In Java the tree can grow very well from 8–15 m in height. In New Guinea it usually grows 5–20 metres tall, though specimens to 30 m have been recorded (Fern et al., 2016). It flowers almost all year round and bearing fruit approximately two months afterward.

Fruit size at harvest was found to be related to the position of fruit on the branch, seed number, spur size, number of fruits set on the spur, and the date of flowering (Tombesi et al., 2015). The position of fruit on the spur, and spur size, were related to blossom size, but not to the subsequent rate of fruit growth (Patricia, 1963). In some countries, flowering usually occurs in early summer followed by fruit ripening 3 months later (Catalog, 2020). The aims of this study was to find out the fruit number in relation to the flowering time.

MATERIALS AND METHODS

Malay apples trees (*Syzygium malaccense*) cultivated in some areas in Central Java namely Banyumas, Purbalingga, Kebumen. Samples were taken from the mature plant which have been fruiting. The number of fruit was counted in all parts of the plants, then the average fruit number per cluster was recorded. Fruit position was determined by canopy categories (Drogoudi & Pantelidis, 2011). There were nine categories i.e. A I, B I, C I (canopy upper part), A II, B II, C II (canopy middle part), A III, B III, C III, (canopy lower part). A is the middle while C is the outer most part, and B is in between A and C. Fruit volume was measured using measuring glass. Data of temperature and precipitation were obtained from Meteorology, Climatology, and Geophysics Council (BMKG) (2018) and Central Bureau of Statistics (BPS) Central Java to know the differences amongst months along the year, the data were analysed with Anova.

RESULTS

Precipitation is very important factor for the formation of Malay apple fruits. The result of this study showed that generally in June, July, and August when the precipitation is relatively low (Figure 1), the fruit number is very high (Figure 3), and the average fruit size was the smallest with a volume between 145–75 mL). On the other hand, when the average precipitation is relatively high from September to April (Figure 1), the fruit size or volume is relatively large (180–500 mL) (Figure 2).

Statistically there is no significant difference between month from the year 2018 to 2021 (Table 1). In fact, the harvest time of Malay apples was unpredictable. In some areas the trees were producing fruits, in other places not like that. However, when we see the fruit production year by year, we can still see that from June to September, many trees are fruiting, and from October to May, only a few trees bear fruit.

Table 1. Anova results

EFFECT	SS	DF	MS	F	ProbF
Blocks	16,765625	3	5,588541667	0,101015893	
Month	902,0572917	11	82,00520833	1,482288199	0,185061051
Residual	1825,671875	33	55,32339015		
Total	2744,494792	47	58,39350621		
C.V. (%): 182.620222801005					
S.E.M.: 3.71898474558297					
S.E.D.: 5.25943866546209					
LSD (p<0.05): 10.7004084208792					
LSD (p<0.01): 14.3755008561844					

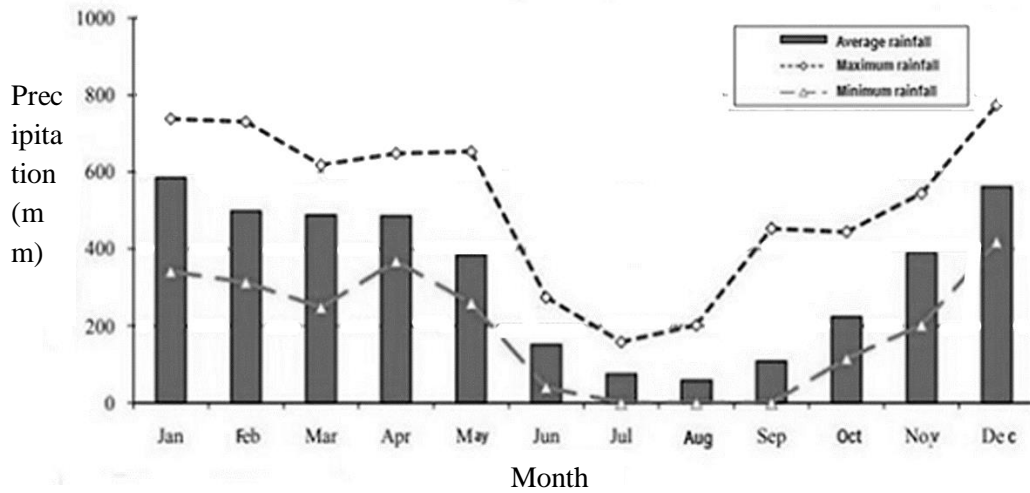


Figure 1. Monthly precipitation in Central Java. Source: PSDA Central Java Province

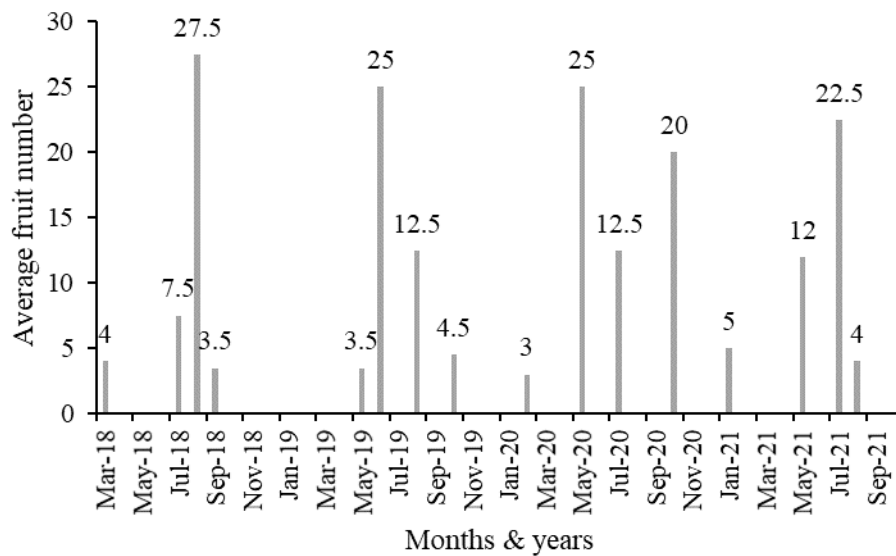


Figure 2. Average fruit number per infructescence of *Syzygium malaccense* from March 2018 to October 2021

The time for harvesting Malay apple fruit has changed over the last few years in line with climate change such as changes in average rainfall and air temperature. As the climate has been irregular, sometimes it rains in dry season, so that there has been no specific time for harvesting Malay apple fruits. This causes the Malay apple to bear fruit at any time of the year. So we found that the Malay apple harvest time varies greatly. This situation is actually very profitable because fruit production can be obtained throughout the year.

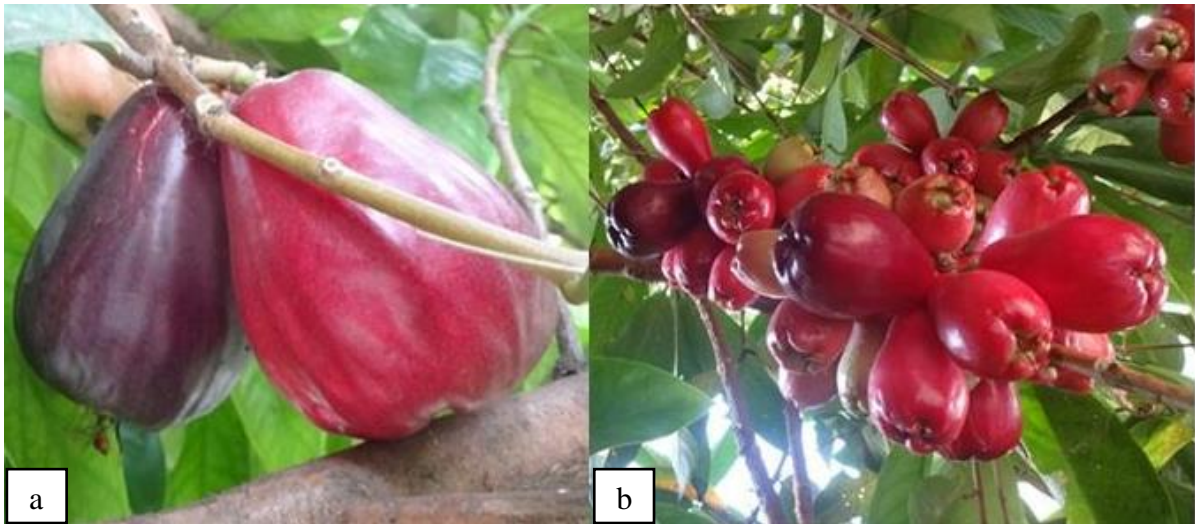


Figure 3. Fruit size depends on how much photosynthate each fruit receives. The size of the fruit in a cluster consisting of 2–3 fruits, is much larger (400–500 mL) (a) than those in a cluster containing many fruits (100–300 mL) (b)

There is a correlation between fruit cluster number and the precipitation with a formula below (Figure 4). When the monthly precipitation is high, the number of fruit clusters is low because high rainfall causes flowers and young fruit to fall. This occurs between October and May. On the other hand, when the monthly precipitation is relatively low, i.e., from May to September, the fruit cluster number is high.

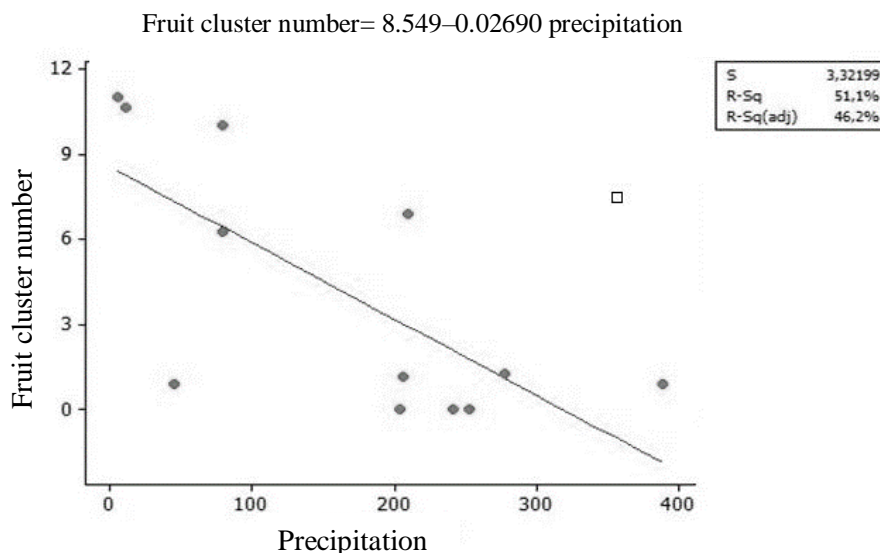


Figure 4. Correlation between precipitation and fruit cluster

Positional Characteristics

The fruit position of Malaya apples can be determined as 1) AI, AII, AIII which are very close to the main trunk namely 0–50 cm from the trunk. 2) BI, BII, BIII are located between 50–100 cm from the main trunk. 3) CI, CII, CIII are located further i.e. >100 cm from the trunk (Figure 5). In wet season (November–March) fruit number is low but fruit volume is high. In dry season (April–October) fruit number tend to be abundant, but fruit volume is low (Table 1).

In wet season, most fruits occurred near the apices of the lower branches, in area B III and C III. While in dry season (May to October), the fruits are widespread either in area B III and C III (lower branches) and AII and B II (middle parts of canopy) (Figure 5). During this season, many meristematic parts of the branches are initiated and give rise to flower buds which eventually become fruit.

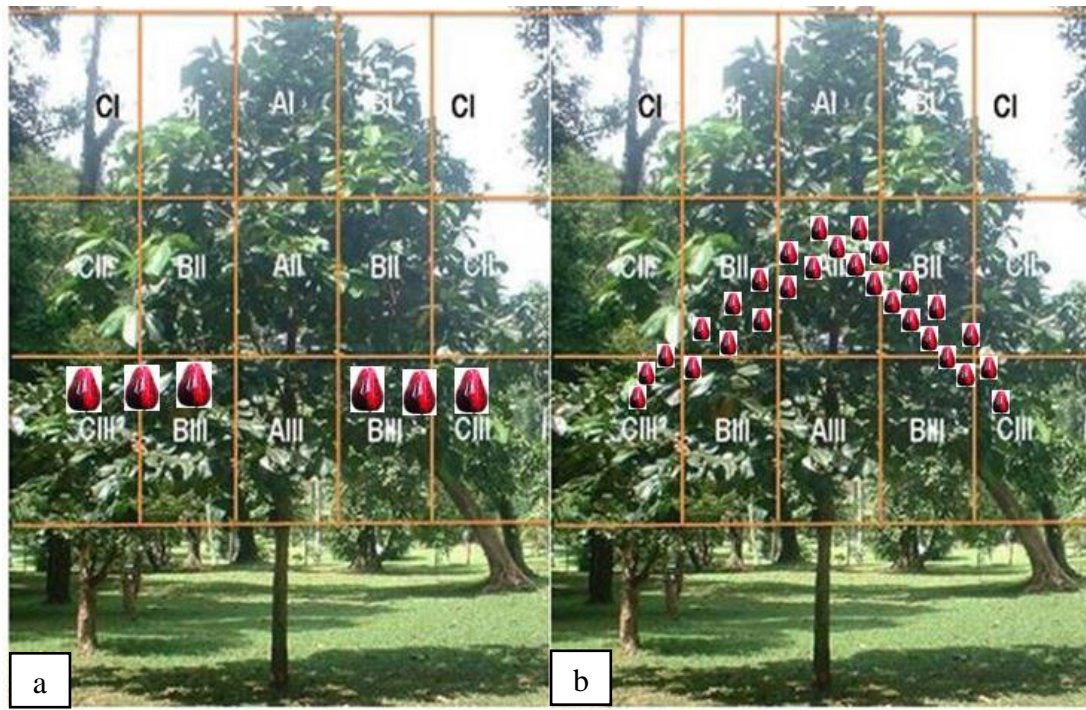


Figure 5. Fruit distribution at canopy parts of *Syzygium malaccense*. In wet season November-March, a few large fruits (a) and dry season (April-October) many but small fruits (b)

Table 1. Fruit harvest calendar of Malay apple (*Syzygium malaccense*) 2018–2021. The harvest time has changed every year

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018				■				■	■			
2019					■	■	■	■	■			
2020			■	■						■	■	
2021		■			■	■	■	■	■	■	■	■

DISCUSSION

Syzygium malaccense flowering time is influenced by the age, temperature, to which the infructescences are subjected. In the past, it was reported by Backer and van den Brink (1963) that Malay apple flowered in March-June, and from October-December. Current situation showed that Malay apple can produce fruit at different time of the year (Figure 3 & Table 1). This may be caused by climate change. Fruit production heavily relies on the environment's light, temperature and humidity changes.

Fruit number may be influenced by 1) tree age, 2) pest, 3) disease, 4) precipitation Kuswandi et al. (2019), and 5) daily temperature. When the age of the tree is still too young e.g. 2-3 years old, in the first flowering time they may only produce 2-5 fruits per infructescence. In the next fruiting time they usually produce more, and more. An increase in the number of flower meristems might aggravate internal competition, which in turn impairs flower development, resulting in a reduced flower quality and consequently smaller fruits (Rindom & Hansen, 1995).

In rainy season (Kuswandi et al., 2019), fertilization process inhibited due to the chance of the pollen cannot attach the stigma, therefore the fruit number decrease. Furthermore, the number of insect around the flower is limited, so that fertilization process is not optimum. In addition, in low temperature, pollen tube growth was also inhibited (Gao et al., 2014). In the year 2021, BRIN predicts that maximum and evenly distributed rain throughout Indonesia will occur in December 2021. In September to October, the number of Malay apple flower and fruit were mostly low, only 3–5 fruits per infructescence.

During high rainfall e.g. October to December when the precipitation is high, the fungal disease spread quickly causing the fruit petiole rotten and the fruit fall down. Anthracnose fungi

spread on deciduous and evergreen trees during overly wet seasons and usually begin on lower branches, gradually spreading up the tree (Jain & Desai, 2018). Leaf blight or anthracnose appears as dark lesions on leaves, stems, flowers and fruit with premature leaf drop (Mertely & Peres, 1969). The results of Anova showed that there is no significant difference between month (Table 1). There is a trend that the highest fruit number occurs between May-September and while from October-April fruit number is the lowest but fruit size is the largest (Figure 2).

Based on the results of the processing of temperature trends in Indonesia by using BMKG observation data from 1981–2018, in general, the temperature in Indonesia, both the minimum, average, and maximum temperatures, has a positive trend with a magnitude that varies around 0.03 °C each year. This means that the temperature will increase by 0.03 °C every year so that in 30 years the location will increase by 0.9 °C (Meteorology, Climatology, and Geophysics Council (BMKG), 2018). Furthermore, since 1900, an increasing trend of rainfall has also been noted. Prior to 1950, the jump occurred on average every 10–20 years. But since 1970, the intensity of rain within a day or two has reached more than 400 mm, as happened in January 2020. Over the past 30 years, there have been more extreme rains that threaten agriculture, shipping, and public safety (Hasbullah & Arief, 2020).

In July, the temperature is the lowest with the average of 25.2 °C. At this condition, temperature affected the rates of fruit growth in volume which could be adequately described using a Gompertz function (Adams et al., 2001). Low temperatures reduced absolute volume growth rates and inhibit the time at which the absolute growth rate became maximal, so that fruit number increase. Similar results have also been reported by a researcher who stated that there was a correlation between fruit number per individual plant and fruit weight (Haryanto, 2012). Furthermore, he also reported that fruit number per branch showed negative correlation with fruit circumference. In this case, our data showed that from June–August 2018–2020 the average fruit number ranged from 20–30 fruits per infructescence. While those from November to February, it was very low (Figure 3).

From 2018 to 2021, there is a tendency that during the rainy season, the number of fruits per cluster is small, while during the dry season the number is large (Figure 3). This is probably due to the dry season (May–September) the success of pollination is very high because it is not exposed to rain. Meanwhile, in the rainy season, many flowers fall due to rain.

In recent years, the Malay apple harvest season has been very difficult to predict. Between May–June 2018 no Malay apple fruit was found, but in the following year (2019) there were many fruits in those months. In January 2019–2020 there is no Malay apples, but the following year (2021) there was. Thus, there is a tendency that the Malay apple harvest season has been changing from 2018–2021. This seems to have something to do with climate change, where there is still a lot of rain in the usually dry season.

On the other hand, there was a tendency that fruit size decrease when the fruit number increase, this be caused by the photosynthesis products were distributed to equally many fruits. Our data showed that from June–August 2018–2020 the average fruit sizes ranged from 3–5 cm wide and 5–8 cm long. The fruit sizes in November to February was normally large namely ranged from 8–12 cm long, and 6–9 cm wide. Similar results have also been reported by Kuswandi et al. (2019), who stated that fruit size increases along with heavy rainfall. There is a correlation between fruit cluster number and the precipitation with a formula in Figure 4.

From November to March, fruit number is low but fruit volume is high located mostly on the edge parts of the tree canopy. It is likely that there was a correlation with the location of auxin hormone which initiate flowering (Yamaguchi et al., 2013). During April–October fruit number tend to be abundant, but fruit size is low, and the fruits are widely distributed both on branches, branches and twigs.

Fruit Calendar

The fruit calendar is very important to determine the steps to be taken on the fruit crops at a certain time so that the fruit harvest time can be predicted. Knowledge of fruit harvesting season is

needed so that farmers and distributors can estimate fruit prices at the level of farmers, distributors, collectors, and retailers. Generally, fruit calendars are based on average harvests over several years. However, this cannot be implemented due to climate change (Ramírez & Kallarackal, 2015).

In 2018 and 2019 there were two harvest seasons namely in April and August-September, which might be caused by the very long wet season. The Meteorology, Climatology and Geophysics Agency (BMKG) estimates that the peak of the rainy season will last from February to March. It is estimated that at that time there was extreme rain (Taufiqqurahman, 2020). In 2019 BMKG stated that the 2019 dry season in Indonesia tends to be longer than it should be. In 2020 and 2021 there were three fruit harvest seasons namely Feb-Mar, May-Jun, and Aug-Nov. There is no specific harvest time for Malay apples. The harvest time has changed every year (Table 1).

CONCLUSION AND SUGGESTIONS

Malay apple production is affected by climate factors like precipitation, the two seasons: the rainy/ wet and dry seasons, and daily temperature. The more the number of fruits, the smaller the fruit size. The average fruit size between May to September are the smallest, while in the other months fruit size were normally large. Fruit harvest may change every year due to many factors especially daily or monthly precipitations and temperature. There is no specific harvest time for Malay apples. Therefore, other research on Malay apple can be carried out in other areas.

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