

Full Length Research Paper

## Morphology of Chok Anan mango flower grown in Malaysia

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A fundamental understanding of mango flowering in the tropics is essential to efficiently utilize cropping management systems which could extend both the flowering and crop production seasons. However, the information and appreciation of the floral biology of this popular fruit species is still lacking. Therefore, the objective of this work was to observe the morphology of Chok Anan mango flowers using scanning electron microscope. The Chok Anan mango flower is monoecious where both the male and hermaphrodite flowers exist in the same panicle. The fruit develops from the hermaphrodite flower while the male flower contributes the pollen when pollination occurred. The Chok Anan mango flowers contained five sepals and five petals arranged in a whorl. There were not much differences in the structure of sepals and petals between the male and hermaphrodite flowers. The structure of the petals is not flat but billowy. Both sepals and petals consist of ground parenchyma tissue with laticifer and idioblast cells, starch granules and vascular bundle tissues. Trichomes are present in both sepals and petals. The male flower has the same structure as the hermaphrodite flower except that it does not have carpel. Further study is needed to understand the peculiarities of the floral morphology to allow us to predict mango production.

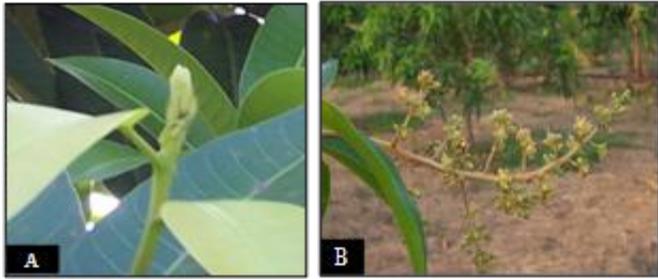
**Key words:** Pollen, sepal, petal, hermaphrodite, floral biology.

### INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most popular fruit of the tropics and belongs to Anacardiaceae family with 60 genera (Abidin, 1991). It is among 15 types of fruits identified in the 3<sup>rd</sup> National Agricultural Policy to be developed as an export crop. 'Harumanis', 'Chok Anan', 'Masmuda' and 'MAHA' are the popular mango varieties planted in Malaysia. Currently, Malaysia produces mango mainly for the local market and only exports small quantity of fruits. The main export destinations are Singapore, Hong Kong and Brunei. In the year 2001, the export was 4165 metric tons valued at RM9.3 million. Analysis based on the production data from 1997 until 2001 predicted that the export value to be as much as 10,

254 metric tons by the year 2010 (FAMA, 2004).

The ability to reproduce is a unifying and essential characteristic of all organisms. Although there are a number of reproduction strategies found in the plant kingdom, sexual reproduction by way of flower and seed production is one of the most common (Kays, 1991). Species of flowering plants are most reliably identified by their flowers, the sexually reproductive organs. A flower is similar to vegetative short shoot (lacking appreciable internodes) that bears 4 kinds of laterally attached organs in successive whorls: sepals, petals, stamens and carpels (Tucker, 2003). Flowering and the fruit set are the most critical of all events occurring after



**Figure 1.** A. Photograph of the initial bud of first week inflorescence where floral shoot arise from a dormant apical bud. B. Photograph of fourth week inflorescence with a few flowers. Male and hermaphrodite flowers are found in the same panicle of inflorescence.

establishment of a tree crop. A fundamental understanding of flowering is essential to efficiently utilize cropping management systems, which would extend both the flowering and crop production seasons (Chacko, 1991). Regulation of flowering allows growers to harvest their crops at the most profitable times.

The information and appreciation of the floral biology of mango is still lacking. Therefore, the objective of this work was to study Chok Anan mango flowers using scanning electron microscope to demonstrate the features which could be useful in the understanding of flower biology. The information obtained from this study can be applied in production of mango especially during pollination.

## MATERIALS AND METHODS

The flowers of Chok Anan mango were taken from 4 three-year old plants grown in the Department of Agriculture, Serdang, Selangor. The flowers were tagged from 3 inflorescences of a tree at the bud and flower initiation stage. The development of floral shoot was observed daily for 5 weeks until fruit set and recorded using a digital camera. 12 mature flowers were picked before flower anthesis on the fourth week. The flowers were immediately fixed using formalin-acetic-acid for 4 h under vacuum. The samples were fixed using the following procedure where they were washed in 1% cacodylate buffer; post-fixed in 1% osmium tetroxide in 0.1 M cacodylate buffer for 2 h and finally washed in 0.1 M cacodylate buffer before dehydration through graded series of ethanol to absolute ethanol and critical point dried in a Balzer CD 30 critical point drier. The flowers were then mounted on stubs, sputter coated with gold and viewed in a JOEL 5610 LV scanning electron microscope (Japan) at an acceleration voltage of 15 kV.

## RESULTS AND DISCUSSION

### Floral shoot development

The floral shoot of Chok Anan mango was initiated terminally from a dormant apical bud of a stem (Figure 1A). The apical bud may turn into leaves or developed

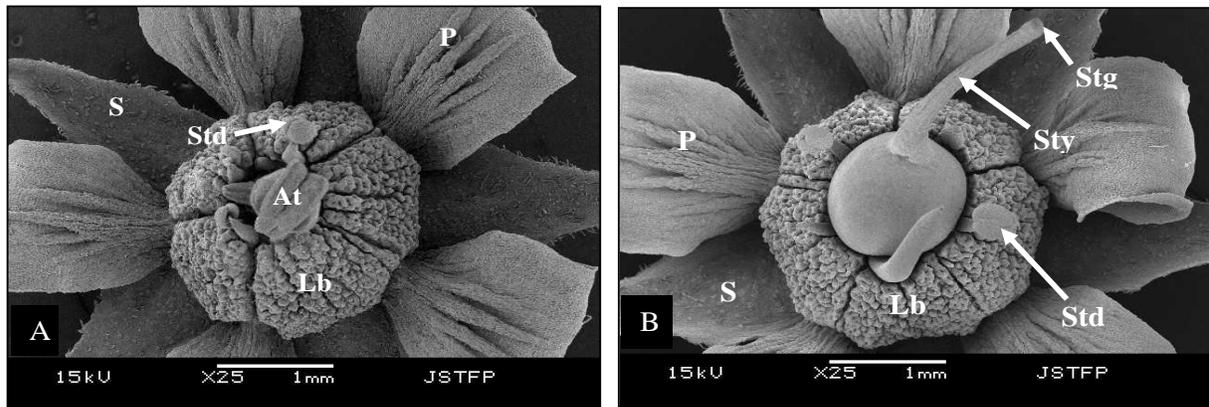
into an inflorescence after 2 weeks. However, factors that determine switching from vegetative to reproductive mode are still poorly understood in mango (Blaikie et al., 2004). The transition to reproductive stage may stimulate by number of different molecules such as carbohydrates, auxins, gibberellins, cytokinin and calcium (Chasan and Walbot, 1993). The initiating bud was green and cone-like shaped. The initiating bud gradually developed into an inflorescence by the third week and flower primordial started to emerge thereafter. The inflorescence formed into a terminal pyramidal green panicle. The structure was rigid and erect and the flower bud developed by the third week. Generally, the panicle colour changed from green to yellow then to pink by the fourth week (Figure 1B). The change in colour was due to the flower colour: green during juvenile, yellow at maturity and pink at anthesis. By the fifth week the fruit set is formed but unpollinated flowers turned brown and aborted.

The panicle of Chok Anan mango inflorescence varies in size. The small panicle has only a few flowers, but the larger panicle could be formed from thousands of flowers; an excess of three thousand flowers were counted in an inflorescence of Chok Anan mango. The flowers were small, monoecious and polygamous. Both male and hermaphrodite flowers with varying stages of anthesis were found in an inflorescence, indicating the flowers were not receptive at the same time. Thus, fruits that are formed have different stages of maturity.

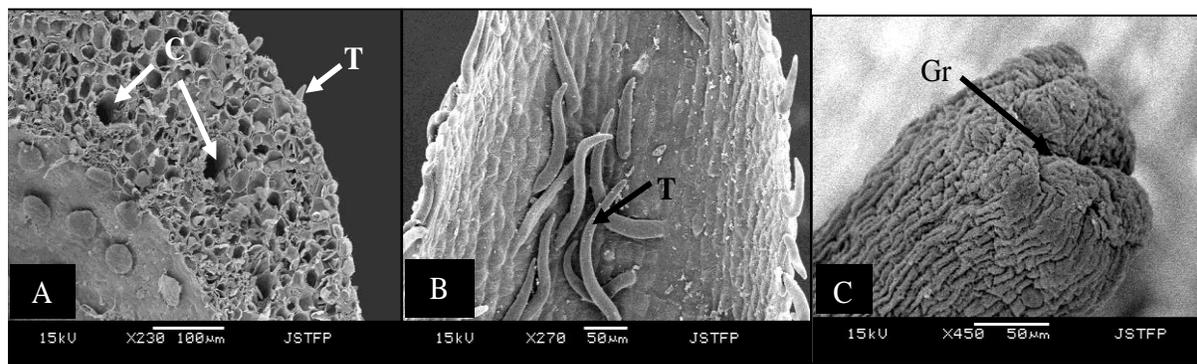
### Flower of Chok Anan mango

By the fourth week of flower development, petals started to open exposing the anther and stigma with full anthesis by the end of the fourth week. Both male (Figure 2A) and hermaphrodite (Figure 2B) flowers were found in the inflorescence. The male and hermaphrodite flowers have similar structure except that the male flowers were without carpel. In the hermaphrodite flower of Chok Anan mango, the carpel is round with an ovary, and the style and stigma are supported by a 5-lobed nectary. Nectary is a secretory structure that release nectar with a high sugar content (Evert, 2006). This indicated insects are the agents for pollination in Chok Anan mango flower. Through secretion of nectar, nectary provides a reward to insects and other animals that serve as pollinators. The fruit developed from the hermaphrodite flower while the male flower contributed pollens during pollination.

The perianth consisted of an outer whorl of 5 sepals and an inner whorl of 5 petals. This is followed by 5 stamens where 1 to 2 of the stamens are with fertile anther while the others are staminodes. There are not much of differences in the structure of sepals and petals between the male and hermaphrodite flowers. The sepals are ovate to ovate oblong and highly pubescent while the petals are oblong, billowy and less pubescent. Both sepals and petals consisted of ground parenchyma tissue with laticifers (Figure 3A) and idioblast cells, starch



**Figure 2.** SEM micrograph showing a male (A) and a hermaphrodite (B) flowers at late fourth week of floral development (x 25). S: sepal, P: petal, Lb: 5-lobed nectary, At: anther, Std: staminode, O: ovary, Stg: stigma, Sty: style.



**Figure 3.** A. SEM micrograph of a sepal. Both sepal and petal contained cavity that believed to be laticiferous cells. C, cavity, T, trichome. B. Trichomes (T) at sepal (x 270). C. The groove (Gr) on stigma of hermaphrodite flower (x 450).

granules and vascular bundle tissues. Laticifers are cells or series of connected cells containing latex and forming systems that permeate various tissues of plant body (Evert, 2006). The laticifers contribute sticky latex when mango flowers being detached. Trichomes were present in both sepals and petals (Figure 3B). Trichomes, in Greek, mean a growth of hair (Evert, 2006). It has a variety of function, however, the functions in sepals and petals of mango flower is unclear.

The style of hermaphrodite flower has a small stigmatic surface grooved as a receptive surface for pollen grains (Figure 3C). In a hermaphrodite flower, the style is longer than the filament of stamen, indicating the existence of some degree of self incompatibility, thus cross pollination is needed. Scholefield (1982) found that 'Haden' mango flower consisted of 1 fertile stamen and 4 short sterile staminodes with the style of carpel shorter than filament of stamen, thus indicating that the floral morphology of mango varies with variety. It is reported that low day/night temperature had a significant effect on floral morphology (style, stigma, ovary and anther size) in

'Nam Dok Mai', 'Kensington', 'Irwin' and 'Sensation' mango cultivars (Sukhvibul et al., 1999).

## Conclusions

To our knowledge this is first report on floral morphology Of Chok Anan mango flower. As reported earlier mango floral morphology can be affected by day/night temperature. Further study is needed to understand the peculiarities of the floral morphology during day/night temperature of drought and wet season to allow us to predict mango production.

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