

## **Phenological Growth Stages of Torch Ginger (*Etlingera elatior*) Inflorescence**

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### **ABSTRACT**

Torch ginger (*Etlingera elatior*) inflorescence with its showy appearance can be used as a cut flower. However, the development of inflorescence has not been studied. The aim of this study is to determine the phenological stages of torch ginger inflorescence from the emergence of rhizome until full bloom stage using the extended BBCH scale. The growth stages of the inflorescence are categorised into peduncle elongation, inflorescence emergence, flowering and senescence. It takes about 60 days for the inflorescence to emerge from rhizome and develop to reach full-bloom stage with true flower opening. This study provides important information in understanding this crop.

*Keywords:* BBCH scale, cut flower, developmental stages, phenology, Zingiberaceae

### **INTRODUCTION**

Torch ginger (*Etlingera elatior*), also known as torch lily, wild ginger or Philippine wax flower, belongs to the family of Zingiberaceae. It is indigenous to Malaysia and Indonesia. In Malaysia, it is called 'kantan'. Torch ginger is usually propagated

by rhizome and seed. It takes about 12 months after planting to start flowering but a longer time is needed when seeds are used. The torch ginger inflorescence is borne on a long, slender and leafless peduncle arising from the rhizome of the ground (Ibrahim & Mood, 2001). The leaves are grown from separate stalks along the rhizome. The torch ginger inflorescence mainly consists of three colours namely red, pink and white. The pink torch ginger is commonly planted in villages while the white and red are rare. The red/pink/white portion of the torch ginger inflorescence is actually the involucre

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bracts. The true flower is cone-shaped and appears between the large waxy bracts.

In Malaysia, the torch ginger inflorescence at tight bud stage is commonly used in culinary dishes. The young inflorescence bud is a compulsory ingredient as flavouring for 'asam laksa', a popular local dish. It is also an important element in many Malay, Nyonya and Thai dishes. Other traditional usage of the torch ginger plant includes the use of the fruit to treat earache and the leaves for healing of wounds and for bathing by post-partum women to remove body odour (Chan *et al.*, 2009). Studies have shown that the leaves contain antioxidant and antibacterial properties (Chan *et al.*, 2007). The leaves, peduncle, inflorescence and rhizome have been used for essential oil production (Sohail & Akhtar, 2011).

Recently, besides commercial production as cooking ingredients, this crop is gaining recognition as an ornamental and landscaping plant in urban areas. In fact, when left to bloom, it is one of the most beautiful and striking inflorescences of tropical flowering plants, and brightens up any garden. The extravagant and showy inflorescence of the torch ginger at each stage can also be used as a cut flower. It has been used in floral arrangements in countries such as Australia, Hong Kong, Thailand and the United States of America. The use of the torch ginger inflorescence as a cut flower is relatively young in Malaysia. There is only a small number of florists using the cut inflorescence as bouquet fillers. However, at farm price, the margin of the cut flower is five times higher than that of the tight bud. Therefore, diversifying the usage of the

torch ginger inflorescence as cut flowers rather than only for culinary purposes would help to increase the marginal revenue of growers.

In Malaysia, the torch ginger inflorescence is frequently harvested at tight bud stage. Therefore, the developmental stages of the inflorescence are rather vague. No study has been done to identify the phenological stages during the development of the torch ginger inflorescence. By understanding the phenological growth stages of the torch ginger inflorescence, it would be easier to access a suitable timing for applying fertiliser and for watering. Improper of maintenance activities will cause the failure of inflorescence development.

Therefore, the aim of this study was to determine the phenological stages of the torch ginger inflorescence from the emergence of the rhizome until full-bloom stage. In this study, the extended Biologische Bundesanstalt, Bundessortenamt and Chemical industry (BBCH) scale (Meier, 2001), with 10 principal growth stages, numbered from 0 to 9, was used to describe the changes of the morphological characteristics of the torch ginger inflorescence. Developing a uniform phenological scale would be a good reference for researchers to identify the growth stages for further study of this crop. Besides, it is also beneficial to growers for more efficient agricultural practices to enhance the inflorescence production. To our knowledge, this is the first report describing the phenological growth stages of the torch ginger inflorescence using BBCH

scale and perhaps, also the first report about the Zingiberaceae family.

### MATERIALS AND METHODS

Pink torch ginger plants planted at Field 2, Faculty of Agriculture, Universiti Putra Malaysia, Malaysia since November 2011 were used in this study. The mean daily temperature during the observation period was 23-35°C with monthly precipitation of 250-300 mm. The inflorescence growth performance of 20 torch ginger inflorescences was observed daily from January to May 2013. The principal growth stage of the torch ginger inflorescence as described in BBCH scale (Meier, 2001) was determined by observing the morphological changes and days taken for the inflorescence to emerge from rhizome until full-bloom stage when true flowers were seen. Fertilisation was done monthly with NPK Blue (12:12:17:2) at 500 g/clump while watering and weeding were carried out when necessary.

### RESULTS

From observation, a torch ginger plant flowers only once. The mean of the inflorescence peduncle length is about 0.7 m. The leafless torch ginger inflorescence is unable to carry out photosynthesis. It is presumed that the growth and development of the inflorescence depends on the stored carbohydrates that are translocated from the mother plant. The phenological stages of the torch ginger inflorescence were summarised and are described in BBCH scale.

#### *Principal Growth Stage 3: Peduncle Elongation*

- 30 Beginning of peduncle growth (Fig.1).
- 32 Peduncle reaching final length of 20% (Fig.1).
- 34 Elongation continues reaching final length of 40% (Fig.1).
- 39 Peduncle reaching final length, elongation process stops and inflorescence bud forms (Fig.1).

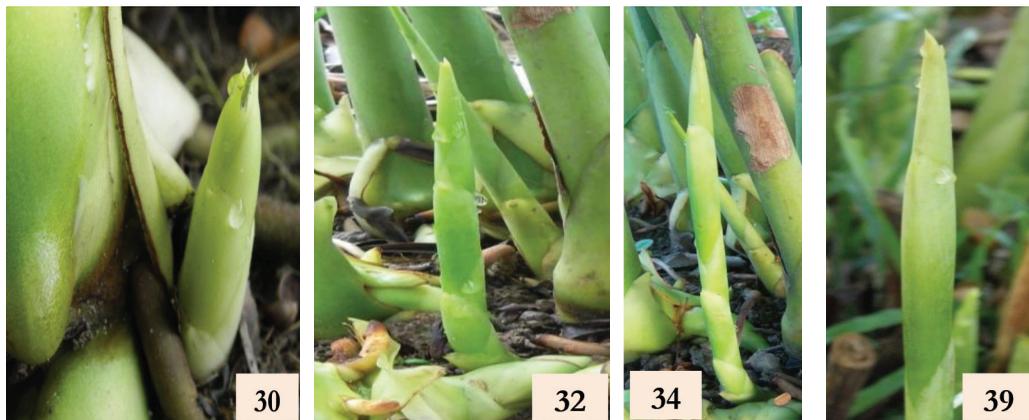


Fig. 1: Principal growth stage 3: Peduncle elongation.

*Principal Growth Stage 5: Inflorescence Emergence*

- 50 Inflorescence bud starts swelling (Fig.2).
- 52 Inflorescence bud swelling, pink pigment starts to deposit in the bracts (Fig.2).
- 56 Inflorescence bud continues swelling until tips form (Fig.2).
- 59 Bracts visible with intense pink colour (Fig.2).

*Principal Growth Stage 6: Flowering*

- 60 Beginning of bract separation and increase in size (Fig.3).
- 62 Opening of bracts at 2-tip (Fig.3).
- 64 Opening of bracts at 6-tip (Fig.3).
- 66 Opening of bracts at 8-tip, causing increase of bract size and layers (Fig.3).
- 68 Opening of bracts, outer layers of bracts unfold revealing a cone-shaped inflorescence head (Fig.3).
- 69 Full bloom, also the end of flowering stage, all bracts unfold and true flowers

show. The longevity of a true flower is just 24 h (Fig.3).

*Principal Growth Stage 9: Senescence*

- 90 Opening of first ring of true flowers complete (Fig.4).
- 95 Full bloom: 50% of true flowers from inflorescence head opened (Fig.4).
- 99 End of blooming: All true flowers opened; inflorescence head turned brown and dry. True flowers failed to develop into fruit and seed (Fig.4).

**DISCUSSION**

In general, it took about 30 days for an inflorescence to emerge from rhizome and develop until inflorescence bud swelling. The development of inflorescence began from elongation of the peduncle and the swelling of the inflorescence bud. During the flowering stage, it took another 30 days from tight-bud stage to reach full

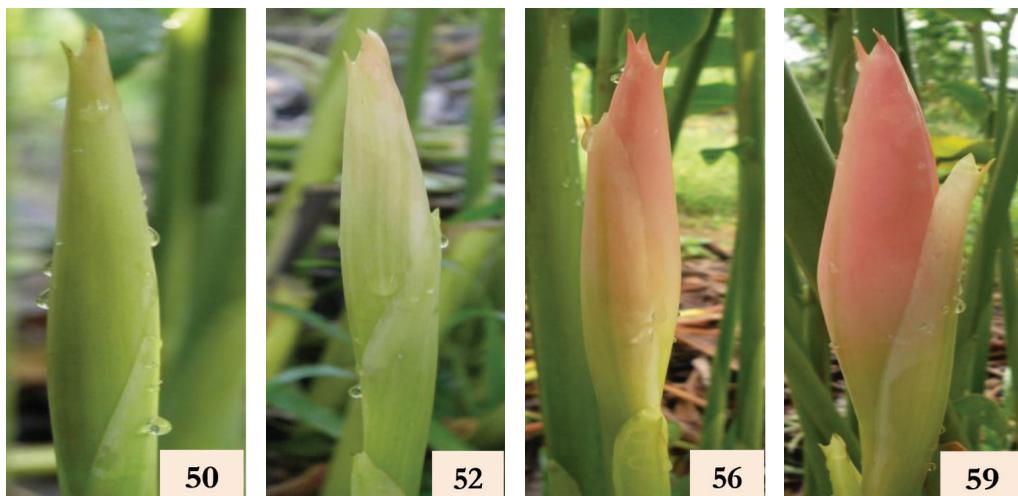


Fig. 2. Principal growth stage 5: Inflorescence emergence.

Phenological Growth Stages of *Etilingera elatior*



Fig.3: Principal growth stage 6: Flowering.

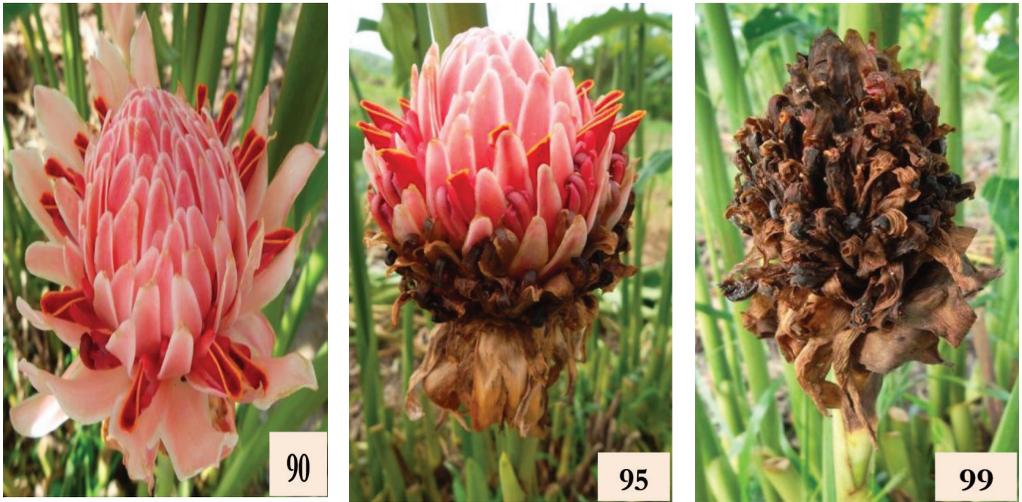


Fig.4: Principal growth stage 9: Senescence.

bloom where true flowers were shown. True flowers were growing in a ring and the opening of true flowers was from outer to inner of inflorescence head. From the opening of the first ring of true flowers, it took about 24 days for all true flowers to open ring by ring. At this stage, the inflorescence head turned brown and dried. The flower failed to develop into fruit and seed due to the absence of the spider-hunter bird, the pollinator, in the study site.

### CONCLUSION

Torch ginger inflorescence showed four of the 10 principal growth stages according to the BBCH scale. The growth stages began with the peduncle elongation, continued with inflorescence emergence and flowering and ended with senescence. The results of this study showed a clear picture of the inflorescence development that provided important information in understanding the crop. This finding could further be used to establish the torch ginger as a cut flower.

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### REFERENCES

- Chan, E. W. C., Lim, Y. Y., Ling, S. K., Tan, S. P., Lim, K. K., & Khoo, M. G. H. (2009). Caffeoylquinic acids from leaves of *Etilingera* species (Zingiberaceae). *LWT - Food Science and Technology*, 42(5), 1026-1030.
- Chan, E. W. C., Lim, Y. Y., & Omar, M. (2007). Antioxidant and antibacterial activity of leaves of *Etilingera* species (Zingiberaceae) in Peninsular Malaysia. *Food Chemistry*, 104(4), 1586-1593.
- Ibrahim, H., & Mood, J. (2001). The torch gingers: Sentinels of the forest. *Garden Asia*, pp.12-19, Jan-Mar 2001.
- Meier, U. (2001). *Growth stages of mono- and dicotyledonous plants*. BBCH monograph. Berlin: German Federal Biological Research Centre for Agriculture and Forestry.
- Sohail, F., & Akhtar, H. (2011). Drying period had a significant effect on the yield of *E. elatior* essential oil production. *Insight Ethnopharmacology*, 1(1), 5-6.