Chapter 7

General discussion

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The studies were focused on the influence of planting dates, night break treatments and/or fertilizer application rates on the physiological response of *Curcuma alismatifolia* Gagnep., a facultative long day (LD) plant (Hagiladi *et al.*, 1997a and Ruamrungsri *et al.*, 2007), as long day photoperiod could promote flowering and quality of spike, while short day delayed flowering (Hagiladi *et al*., 1997b).

On the basis of the results obtained from these studies, it was indicated that each growth and development parameter was influenced by different factors and related with the physiological and biochemical changes in plant. Overall growth and development criteria of plant affected by these factors have been discussed as followed.

Plant height

The results revealed that planting dates and night break treatments influenced the height of *C. alismatifolia* plant. The height of plants cultivated in regular season was significantly greater than that in the off-season. Giving night break significantly increased plant height compared with that of no night break treatment. It might be caused by the extending photoperiod of night break that could stimulate on the rates of translocation and respiration, the accumulation of photosynthates, and carbon partitioning between soluble sugars and starch (Grange, 1985). Moreover, the greater effect on plant height by night break could possibly due to the red: far red (R:FR) ratio,

increase in FR (or low R:FR) in the light environment that caused marked increases in extension growth rates of stems or petioles in some species (Ranwala *et al.,* 2002). In addition, Talon and Zeevaart (1990) suggested that photoperiod might control petiole and stem elongation by regulating GA metabolism. However, growing this plant under regular season provided the most favorable photoperiod condition, critical and sufficient environmental factors that were suitable for growth of *Curcuma.* And thus, the night break did not affect plant growth during regular season planting in *C. alismatifolia.*

Surprisingly, fertilizer application did not influence plant height (Experiment 6). Similarly, Lessa *et al.* (2009) found that the use of mixture of fertilizers did not interfere in the plant height or the interactions between NPK, and the mixture applied did not promote differences in the plant height of *Kalanchoe luciae* Raym either. This was probably due to fertilizer application at full and half recommendation rates promoted the greater number of shoots per clump than the plant height of *C. alismatifolia.* Moreover, application of full and half rates of GAP recommended; 15.0 and 7.5 g pot^{-1}, respectively; did not increase the plant height performance, probably because the amount of nutrients applied was too high, resulting in luxury consumption of nutrients in the treated plants, led them to respond differently.

Inflorescence quality

The data revealed that two main factors affected on inflorescence quality parameters, in terms, of flower stalk length, spike length, green bract and pink bract. However, inflorescence quality of *C. alismatifolia* grown in regular season was better than that grown in the off-season. A similar reported by Hongpakdee *et al.* (2010), suggested that spike length, stalk length, number of green and pink bracts of *C. alismatifolia* planted in regular season was better than off-season. Night break

treatment significantly increased inflorescence quality parameters, in terms of the length of stalk length, spike length, number of green bracts and number of pink bracts, however, it delayed flowering. Similar to that found in gladiolus, the supplemental lighting provided long day condition, which specifically and directly promoted flower growth of gladiolus (Shillo and Halevy, 1981). This might be due to the distribution pattern of assimilates during development, that there were two competing sinks, i.e. the inflorescence and the underground part. The inflorescence was the main sink during the period of accelerated flower development, in which long day conditions strengthened the sink activity of the flower by promoting the distribution of dry matter towards the flower and away from the rhizome to the development of flower quality (Robinson *et al.,* 1980). This result was confirmed by Ruamrungsri *et al.* (2005), it was found that extended day length using night break treatment by supplying 2 hrs of an artificial light source could promote the flowering percentage of curcuma plant. Similarly, Changjeraja (2009) suggested that supplemental lighting promoted number of pink bracts and spike length of this plant. Chidburee *et al.* (2008) found that curcuma grown under photoperiod of 13 hours did not cause flower abortion as compared with 7 and 10 hours of day length conditions. Similar to Chin (2007), who determined that supplemental lighting gave the best quality flowers with uniform flowering, as well as, the intense flower color.

Leaf area

The results showed that only planting date treatments affected leaf area of *C. alismatifolia* at growing period. Planting in regular season significantly increased leaf area of vegetative growth. This was possibly due to May planting, the temperature and photoperiod prevailed during this time, was perhaps favorable for maximum

vegetative growth of the plants and led to formation of greater photosynthetic products which resulted in increased growth of this plant. A similar event was found in *Hippeastrum*, that August planting was the most suitable for profuse growth and flowering (Siddique *et al.,* 2007).

Number of shoots per clump

The research found that planting dates and fertilizer application rates affected on the number of shoots per clump. Planting in regular season could increase more shoots numbers than planting in the off-season. Similarly, Payakaihapon and Ruamrungsri (2006) found that off-season planting, with the addition of light supplement condition using continuous light for 2 hours, gave the best result, in terms of the number of shoots per clump, number of flower per plant, number of new rhizomes, size and weight of new rhizomes. This was possibly due to photosynthesis period was extended under supplemental lighting in OS condition, brought about the increase of photoassimilates for promoting growth parameters, i.e. number of shoots per clump, which corresponded with results obtained by Gunnlaugsson and Adalsteinsson (2006). This effect of clump size could be explained by the fact that fast photosynthate translocation caused by large sink size, resulted in a high photosynthetic rate (Gosselin *et al.,* 1996). In addition, fertilizer application at GAP and ½ GAP recommendation rates gave the greater number of shoots per clump.

Rhizomes quality

The data showed that planting dates and fertilizer application rates significantly influenced the rhizomes quality attributes of *C. alismatifolia*. Planting in the off-season gave better rhizomes quality, in terms of rhizome fresh weight, total fresh weight and number of rhizomes, than those in the regular season. Short day was believed to directly

promote underground growth (rhizomes and storage roots). A similar, result was observed by Shillo and Halevy (1981) in gladiolus. Under long day, there was almost no increase in dry weight of the rhizome, and the preference of dry matter allocation to the flower was increased. It seemed that short day specifically promoted growth and sink activity of the rhizome (Robinson *et al.,* 1980). It was indicated that, long daylength inhibited storage roots formation, while short day length stimulated earlier storage roots formation. Similarly, Ruamrungsri *et al*. (2004) found that the light interruption by 2 hours of night break could inhibit storage roots formation in curcuma plant, although it was in winter. Photoperiod was reported to play a key role in the induction of *in vitro* storage organs (Tyagi *et al.,* 2006). Besides, fertilizer application rates could promote better product quality. Because increased fertilizer application could be attributed to the enhance of physiological processes in crop plants leading to higher growth and increased photosynthates to sinks, in turn this might resulted in the increase rhizomes quality and the number of rhizome per plant (Selvaraju and Iruthayaraj, 1994). Changjeraja (2009) reported that the long photoperiod at 14 hours delayed storage roots formation of this plant. On the other hand, the short day at 6 and 10 hours stimulated early storage roots formation. Similarly, Chidburee *et al.* (2008) found that under day length at 7 hours number of new rhizomes per plant and number of storage roots per rhizome decreased.

These information found here could be useful for growers who would like to produce off-season cut flowers or good quality rhizome production of *C. alismatifolia*. The technique of extending photoperiod by supplying 2 hours of an artificial light and applied fertilizer could promote plants growth. The recommended

rate of fertilizer application in order to obtain a good vegetative; as well as, reproductive, growth of *Curcuma* would be 7.5 g pot^{-1} (½ GAP recommended).

Results from this study were led to the conclusions as followed;

1) *Curcuma alismatifolia* planted in regular season along with addition light supplement condition increased greater plant height.

2) Regular season planting with night break application provided better inflorescence quality, in terms of number of green and pink bracts, flower stalk length and spike length, however, night break condition delayed flowering.

3) Planting this plant in regular season and 7.5 g pot^{-1} recommendation fertilizer rate could promote greater number of shoots per clump.

4) Under short day condition (off-season) along with 7.5 g pot^{-1} recommended fertilizer rate gave better rhizome quality, i.e. number of rhizomes, rhizome fresh weight and total fresh weight.