Chapter 1

Introduction

Geophyte is a perennial plant with an underground food storage organ, such as a bulb, tuber, corm, or rhizome. The parts of the plant that grow above ground die away during adverse conditions, as in winter or during the dry season, and grow again from buds that are on or within the underground portion when conditions improve.

Generally in geophytes, cyclic patterns of growth, flowering and rest periods involve a sequence of specific endogenous processes, which are expressed in the growth and differentiation of the shoot and in changes occurring in the storage organ (Flaishman and Kamenetsky, 2006; Le Nard and De Hertogh, 1993). These developmental transitions are usually associated with changes in the levels of plant hormones, enzyme activities, nutrient status, amino acids and stored carbohydrate, which are probably involved in the control of flowering and dormancy. The developmental transitions in many geophytes are following the seasonal changes in the environmental conditions, such as temperature, day length, light intensity, relative humidity and water status (rain falls) (Flaishman and Kamenetsky, 2006; Le Nard and De Hertogh, 1993). Moreover, variation in some levels of hormones like abscisic acid

(ABA), gibberellins (GA) and cytokinin (CK) reflect plant responses to those changes in the environment (Araki, 2001; Levy and Dean, 1998; Yu *et al.*, 2006) and are involved in these phenologic transitions (Ile *et al.*, 2006; Ofir and Kigel, 1998; Okubo, 2000; Suttle, 2004; Yamazaki *et al.*, 2002).

Curcuma alismatifolia Gagnep. belongs to the group of tropical and sub tropical geophytes (Apavatjrut *et al.*, 1999) which requires a habitually environmental periods of long day, high temperature and sufficient water (rains fall) for their normal growth and flowering during the rainy season, follows by short day, low temperature and drought for dormancy during cool dry winter (Wichailak, 2005).

In Thailand, regular season cropping for *Curcuma* usually starts from April to May by planting stubbed rhizomes with several storage roots. Shoots sprout within 4-8 weeks after planting. The flowering appears from July to August, during the rainy season and the shoot becomes ceased prior to dormancy periods in cool dry season (winter) during November to December (Ruamrungsri *et al.*, 2001). The off-season cropping of *Cucuma* is a profitable technique for growers to control their excess product as usually occurs in regular season cropping, and to increase their income, since the price for that time is frequently the cheapest of the years. Although *Curcuma* plants can be grown widely in areas cover from tropical to temperate regions, but off-season cropping appears to reduce the quality of flowers and rhizomes. The growth patterns and quality of crops may be influenced by modification of plant hormones and metabolites (Thomas and Vince-Prue, 1997).

Revealing the nature and time-course of the different developmental changes, such as stimulated shoot growth, induced flowering or promoted rhizomes yields, between both seasonal cropping would contribute to a better understanding the role of endogenous hormones in controlling cyclic patterns of growth in *Curcuma*. Here, a quantitative study of the seasonal cropping affected in the levels on some endogenous hormones (ABA, *t*-ZR and IAA) and other biochemical substances during the growth cycle of *Curcuma*, was reported as in **'chapter 3'**.

In addition to the results obtained by the comparison of the regular season cropping and off-season cropping in the field in chapter 3, the distinct environmental conditions in the off-season that short day length and low night temperature could alter the plant growth, fluctuated the ABA and *t*-ZR concentrations and other biochemical substances in all plant organs, were investigated to confirm plant responses and possible role of some distinctive environmental parameters was also examined again under controlled condition as independent factors, i.e. photoperiods and temperature in **'chapter 4'** and **'chapter 5'**, respectively.

Finally, the proving result in chapter 4, in which photoperiods strongly affected in endogenous hormonal changes rather than the temperature in chapter 5, led to the hypothesis that decreasing ABA concentration in plants by using night interruption, similar to long day, and applying gibberellins and fluridone might enhance the growth, flower quality and rhizome yields of *Curcuma* as demonstrated in **'chapter 6'**.

Objectives

1. To investigate the effects of production season on some endogenous hormones and other biochemical substances in *Curcuma alismatifolia* Gagnep.

2. To evaluate the distinct environmental condition aspects; i.e. photoperiods and temperature, on some endogenous hormones and other biochemical substances in *C. alismatifolia* Gagnep.

3. To evaluate the relationship between the changes in endogenous hormones and other biochemical substances and physiological aspects of *C. alismatifolia* Gagnep.

4. To determine an appropriate technique for promoting the growth, flower quality and rhizomes yields by modification of some endogenous hormone levels in off-season cropping of *C. alismatifolia* Gagnep.