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Breaking Bud Dormancy and Different Shade Levels for Production of Pot and Cut *Cucurma alismatifolia*

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Abstract: Problem statement: *Cucurma alismatifolia* is a member of the family Zingiberaceae. It is widely grown in Thailand and is also a highly demanded plant in Holland and Israel where it is grown for cut flowers and as pot plants. *C. alismatifolia* has a good potential as a new flowering crop in the floriculture industry. The development of new flowering pot plants is of interest to commercial growers, nurserymen as well as hobbyists. Noted for its showy inflorescence and unique foliage, this plant is long lasting and durable. It is an herbaceous with short fleshy rhizomes and tuberous roots, often with a dormancy period. Breaking of the bud dormancy on the rhizomes of *C. alismatifolia* is very important as to overcome the problem of eye bud emergence and to provide planting material throughout the year. There is little information on the optimum production environment and cultivation practices of this species. **Approach:** This study reported on the study of plant morphology, the effects of BAP and ethephon in breaking bud dormancy of *C. alismatifolia* and the effects of different shade levels on the growth and flowering of *C. alismatifolia.* **Results:** BAP at 100 mg L^{-1} recorded the most number of eye buds appearance while ethephon at 750 mg L^{-1} gave the most number of eye emergence. Data obtained shown that the optimum shade level for the production of *C. alismatifolia* potted plant was at 30%. **Conclusion:** For commercial production of *C. alismatifolia* as a cut flower, a shade level of 70% is highly recommended, as it exhibits a good characteristic for a cut flower at this shade level.

Key words: *Cucurma alismatifolia*, plant morphology, bud dormancy, flowering, commercial value

INTRODUCTION

Cucurma alismatifolia is a member of the family Zingiberaceae. It is grown widely in Thailand (Skornickova, 2006) and is also a highly demanded plant in Holland and Israel where it is grown for cut flowers and as pot plants. *C. alismatifolia* has a good potential as a new flowering crop in the global floriculture industry of our country and development of new flowering pot plants is of interest to commercial growers, nurserymen as well as hobbyist. Noted for its showy inflorescence and unique foliage, the inflorescence is long lasting and durable.

The inflorescence bracts (modified leaves) are nearly always differentiated into two types (Fig. 1A). The basal bracts are essentially green and persistent. These bracts are fertile and bear up to seven more or less concealed flowers. The upper colored bracts form the pink part of the inflorescence. The bloom which is held above the foliage does look like a tulip. *C. alismatifolia* is a herbacoeus perennial with short fleshy rhizomes and tuberous roots, often with a dormancy period (Fig. 1B) (Burch *et al*., 1987).

As an ornamental ginger, propagation of the species is mainly through their geophytic units, or rhizomes. The rhizomes are thus the major source of food for the plant. In general, the total growing period is 8 months, mainly during the rainy season (March to October) and flowering occurs only after 4 months from the day of germination. Flowering is followed by initiation of new rhizome. During the dry season, the rhizomes become dormant. Rhizomes in commercial production are harvested at this time for commercialization. Breaking of bud dormancy on rhizomes of *C. alismatifolia* is very important as to overcome the problem of eye bud emergence and to produce the plant year round. Inflorescence stalks of this species arise from a pseudostem and often tend to extend a long way from the foliage, which lowers the commercial value of the plants. Potted cucurma is most often grown to a standard of 1.5-2 times the height of the container. On the other hand, a long inflorescence spike is beneficial for the cut flower market.

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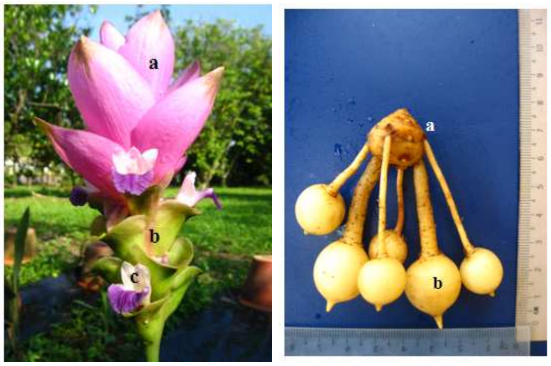

(A) (B)

Fig. 1: (A) Inflorescence of *C. alismatifolia*; (a) Upper bract, pink; (b) lower bract, green; (c) true flower; (B). Rhizomes of *C. alismatifolia*; (a) rhizome; (b) storage root

Shading plays an importnat role in the growth and flowering of many flowering ornamentals. According to (Treshow, 1970), light intensity is not only important in the photosynthesis process and food production in plants but is also important for plant growth and development. There is little information on the optimum production environment and cultivation practices of this species. Therefore, this study attempts to cover the study on the effects of BAP and ethephon in breaking bud dormancy and to evaluate the various shade levels on the growth and flowering responses of *Curcuma alismatifolia*.

MATERIALS AND METHODS

Two separate experiments were conducted to study the effects of BAP and ethephon in breaking bud dormancy of *C. alismatifolia*. In experiment 1, six concentrations of BAP at 0, 50, 100, 150, 200 and 250 mg L^{-1} were applied, while in experiment 2, six different levels of ethephon concentration was used, with 0 (control), 150, 300, 450, 600 and 750 mg L^{-1}. BAP and ethephon treatments were applied to rhizomes by soaking into the sterilized BAP and ethephon for about 30 min. The rhizomes was then taken out and placed on moistened cotton under sterilized condition in flasks. The flasks were then placed in the incubation room at room temperature of 2±3°C for 24 days under 16 h photoperiod (18 µ mol m^{-2} sec^{-1}). Data on days to visible bud, percentage of bud sprouts, shoot length and rhizome weight gain was taken. The data collected was analyzed by Statistical Analysis Software (SAS) version 9.1 and means were separated by Duncan's Multiple Range Test (DMRT).

In the study of effects of different levels of shading on growth and flowering of *Cucurma alismatifolia*, the rhizomes were treated with Benlate® before planted in a mixture of 1 top soil: 2 organic matter (cocopeat and paddy husk). Plants were grown under four levels of shading. T1 (0%, without using black net); T2 (30% shade); T3 (50% shade) and T4 (70% shade). The average light intensity measured for T1, T2, T3 and T4 was 1108.67, 645.32, 402.08 and 296.86 µmol m^{-2} sec^{-1} respectively. One rhizome was planted per pot of 25 cm diameter. Twenty plants were grown under each treatment. Fertilizer NPK Blue was applied once a month at a recommended rate of 5 g per pot. Malathion® and Benlate® were sprayed weekly to prevent the plants from unwanted pest and diseases. Mitac® was sprayed to control red spider mites. Growth and flowering parameters measured were plant height, number of days to shoot emergence, number of days to first visible bud, number of days to a thesis, number of days to senescence, flower stalk length and inflorescence length. Flower stalk was measured form the point of growth to the tip of the inflorescence. Inflorescence length was measured by the vertical length of the colored inflorescence. The data collected was analyzed by Statistical Analysis Software (SAS) version 9.1 and means were separated by Tukey's Honesty Significant Difference (HSD) test.

RESULTS

In experiment 1, the number of eye bud breaks was reduced as the concentration of BAP increased. There was significant effect on the number of days to visible bud. BAP at 100 mg L^{-1} gave the earliest time for visible bud appearance as compared to control and the other concentrations. There were significant differences for rhizome weight gain among treatments. However, no significant differences were observed among treatments for shoot length (Table 1). There was an increase in the time for number of days to visible bud formation with increasing BAP concentration.

In experiment 2, the number of eye bud emergence on the rhizomes of *C. alismatifolia* increased as the concentration of ethephon increased. There were significant effects for days to visible buds, percentage of bud sprouts (%), shoot length (cm) and rhizome weight gain (g) (Table 2). Ethephon at 750 mg L^{-1} gave the most eye buds emergence that is at 5 eye buds while at 150 mg L^{-1} and at control (0 mg L^{-1}) eye buds emergence was at 2.25 eye buds. There were significant differences on increased in rhizome weight gain among treatment as well as for shoot length.

Table 1: Effects of BAP on days to visible bud, percentage of bud sprouts (%), shoot length (cm) and rhizome weight gain (g)

Treatment (mg L^{-1})	Days to visible bud	Percentage of bud sprouts (%)	Shoot length (cm)	Rhizome weight gain (g)
0	5.5a[z]	15.53b	0.31a	0.18abc
50	4.3ab	15.63b	0.26a	0.13bc
100	3.3b	23.75a	0.36a	0.26ab
150	3.5b	20.50ab	0.32a	0.27a
200	4.8ab	13.54b	0.28a	0.13bc
250	5.5a	15.66b	0.27a	0.10c

[z]: Means within the same column followed by a common letter are not significantly different at $p<0.05$ based on Duncan's multiple range test

Table 2: Effects of ethephon on days to visible bud, percentage of bud sprouts (%), shoot length (cm) and rhizome weight gain (g)

Treatment (mg L^{-1})	Days to visible bud	Percentage of bud sprouts (%)	Shoot length (cm)	Rhizome weight gain (g)
0	5.50a[y]	12.88b	0.27b	0.14b
150	4.50ab	11.39b	0.31b	0.15b
300	4.00bc	15.90ab	0.27b	0.18b
450	3.75bc	15.00b	0.30b	0.16b
600	3.00c	22.95a	0.36ab	0.23b
750	3.50bc	22.50a	0.44a	0.41a

[y]: Means within the same column followed by a common letter are not significantly different at $p<0.05$ based on Duncan's multiple range test

Table 3: Effects of different shade levels on plant height, number of days to shoot emergence, number of days to first visible buds, number of days to anthesis, number of days to senescence, flower stalk length and inflorescence length of *C. alismatifolia*

Treatments	Plant height (cm)	Number of days to shoot emergence	Number of days to first visible buds	Number of days to anthesis	Number of days to senescence	Flower stalk length (cm)	Inflorescence length (cm)
0%	39.080d[x]	50.800a	84.600a	91.200a	46.500a	56.480b	12.610a
30%	58.390c	28.600b	60.700b	68.400b	42.500ab	57.850b	11.920a
50%	71.820b	25.300bc	55.800b	62.700b	35.300bc	74.060a	10.840a
70%	82.700a	23.200c	57.000b	63.800b	37.600c	78.250a	11.280a
Statistical differences	**	**	**	**	**	**	ns

[x]: Means within the same column followed by a common letter are not significantly different based on Tukey Studentized range test at ($p<0.05$) level

Ddifferent levels of shading had significant effect on the growth and flowering of *Cucurma alismatifolia*. Results obtained for growth and flowering parameters shown that there were significant differences for plant height, number of days to shoot emergence, number of days to first visible bud, number of days to a thesis, number of days to senescence and flower stalk length. However, there was no significant difference in inflorescence length (Table 3). In general, plant height increased with increasing shade level. The increment in plant height was 52.7 under 70% shade and it increased by 29.4 and 13.2% fewer than 30 and 50% shading respectively, compared to 0% shade. Shading also shortened the duration for shoot to emerge. Plants under 0% shading emerged very late (51 days after planting) as compared to plants grown under 30, 50 and 70% shading. On the other hand, plants grown at 70% shading emerged 28 days earlier than those in the control plot (0% shading). Number of days to first visible bud and days to anthesis was highly significant at the different shade levels. The day visible buds were noticed and plants bloom was the earliest for plants grown under 50% shade. Flower longevity was longest (47 days) under 0 shade, 30 (43 days) and 70% shade (38 days). Plants grown under 50% shade were the earliest to senesce at 35 days after flowering. Flower last longer for blooms at 0% shade. Flower stalk length increased with increasing shade levels. There was no significant difference between the treatments for inflorescence length (Table 3).

DISCUSSION

BAP at the concentration of 100 mg L^{-1} has been shown to successfully breaking bud dormancy of rhizome of *Curcuma cordata* and produced the highest mean shoot length. BAP also influenced the number of shoots of *Zingiber officinale* at the concentration of 1 mg L^{-1} using liquid culture (Arimuna *et al*., 2000).

The rhizome of *Zingiber officinale* Roscoe 'Chinese' treated with 750 ppm of ethephon produced the highest number of shoots, highest mean shoot length and highest rhizome weight compared with untreated rhizome (Furutani *et al*., 1985). Furutani and Nagao (1986) also reported that the number of shoots of *Zingiber officinale* increase with the increasing concentration of ethephon. Ethephon has been found to assist in swelling and bulb formation on the bulbs that were not exposed to long day treatment. Normally, a long day treatment between 12 and 16 h are required for bulb formation (Levy and Kedar, 1970; Corrales-Maldonado *et al*., 2010; Mahadtanapuk *et al*., 2007).

Increasing shade levels increased plant height. *C. alismatifolia* and the other ornamental ginger produce plants with tall inflorescences and this result in unmarketable potted plants due to excessive height (Nelson, 2002). Paz (2003) have concluded that to produce a plant of good quality to the market, potted plants of *C. alismatifolia* must be grown in full sun. Shading provides a plant with lower soil temperature. Evenson *et al*. (1970) indicated that an optimum soil temperature greater than 25°C but less than 30°C is for the germination and early growth of ginger is required for $3^{1/2}$ to 4 weeks for shoot to emerge. Rhizomes of *C. alismatifolia* should be planted under shade so as to shorten the germination process and to further enhance commercial production of *Cucurma*. The growth of plants grown under shading was faster as compared to that of control. This could be due to the shorter time taken during the emergence of shoots for plants grown at 30, 50 and 70% shade. This is probably because shoot emergence of plants at 0% shade is the latest and more food reserved occurred at this shade level. According to Kuehny (2001), the postproduction longevity of this species is about 40 days. Paz (2003) reported that plant height and flower height for potted *C. alismatifolia*, when grown at 30 and 60% shade, was significantly taller by 9 and 13 cm respectively.

CONCLUSION

For commercial production of *C. alismatifolia* as a cut flower, a shade level of 70% is highly recommended, as it exhibits a good characteristic for a cut flower at this shade level.

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