熱帯圃場条件における × Aranda Christineの摘芽による開花期の制御

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Control of Flowering by Floral Bud Removal in ×*Aranda* Christine under Tropical Field Conditions

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Summary

The growth and flower production of × *Aranda* Christine cv. "130" grown under tropical field conditions were studied. On the average, an *Aranda* orchid produced 2～5 leaves and an increase of 7 cm in height per month for the first 18 months after transplanting. Cut flower production was evident only 5 months later. *Aranda* has 3 major flower peaks-April, June and December. Cut flower production of × *Aranda* Christine could be successfully staggered by floral bud removal. Through bud removal, it is possible to shift the flower production peak for 2 weeks. No apparent effect of bud removal on flowering and flower quality was observed as the subsequent flowering behaviour was normal.

Introduction

Export of tropical orchid cut flowers contributes in no small part to the economy of Thailand and Singapore. Singapore, for example, exports over 10 million dollars worth of cut orchid flowers annually. Top on the export list is the *Aranda* flower. In fact, the export of *Aranda* flowers forms 50～60% of the total cut flower trade. ×*Aranda* Christine is one of the more popular *Aranda* flowers for export.

In contrast to the efforts made in breeding (13), work on improvement of agronomic practice of the *Aranda* orchid is rather limited (15, 16, 17), though considerable attention has been given to its photosynthesis(1,4, 6), respiration(5), postharvest physiology(7), flowering(3) and mineral nutrition(8).

An important aspect of the commercial orchid cut flower production is to have the flower production coincides with the market demand. This can be done by selecting cultivars which flower at different seasons to cater for the market demand(2). To do so, reliable record of the seasonality of the flowering is essential.

Alternatively, one can attempt to control flowering by manipulating the photoperiod, temperature, available sunlight and water and the use of certain chemicals.

Flowering of *Aranda* hybrids is not controlled by the photoperiod(3). Total flower production in ×*Aranda* Christine cv. "1" decreased if the climatic conditions were dry and it flowered better under warmer conditions (14). Stem decapitation or incision stimulated the production of axillary shoots in ×*Aranda* Christine(3, 9). The nature of the axillary shoots, either vegetative or reproductive, was shown to be correlated with their positions along the stem axis. The commercial application of decapitation or incision method of controlling flowering of ×*Aranda* Christine cv. "1" has been explored(9). It had appeared that decapitation method might be suitable for plants due for replanting as it was for one harvest crop. The practicality of the incision method for commercial application remained doubtful. There was no mention of the vase-life and marketability of flowers obtained by either of these methods(9). Also, the long term effects of decapitation or incision method on subsequent flowering in terms of quality, quantity and seasonality were not clear.

Chemical regulation of flowering in ×*Aranda* Christine cv. "1" has also been reported.

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Flowering of ×*Aranda* Christine was stimulated by the application of cytokinin(10). The potential danger of having abnormal flowers as a result of hormonal application was not discussed. Recently, Zaharah *et al.* (18) have observed abnormal flowers in *Dendrobium* following BAP application.

Murashige *et al.*(12)have successfully altered the flowering behaviour of *Vanda* Miss Joaquim simply by the romoval of flower buds. This method is easy and appears to be rather safe. We report here our observations on the effect of debudding (removal of flower bud) on the staggering of flower production of ×*Aranda* Christine. The effect of debudding on the longevity and marketability of flowers produced and on subsequent flowering behaviour was also studied.

Materials and Methods

×*Aranda* Christine cv. "130" (*Arachnis hookerana*×*Vanda* Hilo Blue) is grown in the field under full sunlight. Top cuttings which measured 60 cm with 2~3 roots were planted in a single row. Plant density adopted was 22 plants per 4.2 m² or plants which were spaced about 20 cm apart and wood shavings is used as mulch, as practised by most nurseries (11, 15).

The environmental conditions in the field during the experiment were as follows:

Environmental Parameter	
Temperature (℃)	max. 36℃, min. 24.8℃
Relative humidity (%)	max. 98%, min. 51.8℃
Water pH (average)	6
Soil pH (average)	4.2~5.0
Rainfall (average, mm/month)	164.3
Light intensity at noon (average lx)	65,000
Total sunshine hours (average/month)	166.3

For growth studies, 2 groups of plants with 352 plants each were grown in the field. Each group consisted of 16 plots with 11 plants in each plot. At regular intervals, the plant height and production of new leaves and flowers were measured. Measurements were made on the first day of the month. Experiments were initiated in November 1980 and terminated in May 1982. The plants were fertilised twice a week with the Gaviota 63 alternate with 67 at recommended dosage of 907.2 g per 454.6 *l* water. Application of fungicides (Tersan and Captan) was done twice weekly at the rate of 1 lb per 100 gallons water while application of Triluzon was carried out once a week at 1 litre per 100 gallons water. Systemic fungicide and insecticide were applied once in every 2 months. To have a reliable record of the seasonality of flowering, flower production of a large population of 25,703 *Aranda* plants was carried out over 3 years (1980–1983). The environmental conditions and agronomic practices were the same as mentioned earlier. Cut flower production was measured as total inflorescences produced per month. Flowers harvested were at 80% bloom.

For bud removal experiments, uniform 2 year-old *Aranda* plants in the field were used and debudding was carried out in May 1983. Bud removal was done at an average spike length of 5 cm. Experiments were carried out with 3 groups of plants, each with 680 plants. The flower production in the 3 groups was recorded at weekly intervals. The measurement of the longevity of flower was carried out in an air-conditioned room kept at 25℃ and 75% R. H.

Results

Growth and Flower Production

A rather linear increase in height was observed (Table 1). The growth in height appeared to have slowed down after 18 months. No lag period was evident. In contrast to height increase, there was a lag period of about 1 month in the new leaves production. Production of new leaves began to level off after 18 months. On average, an *Aranda* orchid produced 2.3 leaves and an increase of 3.4 cm in height per month for the 18 months after planting.

Flower production of *Aranda* began 5 months after planting in October 1980. Sizeable production was evident only in June 1981, with each plant producing 1 spike each. With time, the production increased. By May 1982, each plant produced an average of 9 spikes. Table 2 shows the flower production and seasonability

Table 1. Growth and flower production of ×*Aranda* Christine cv. "130" grown under tropical field conditions.

Month	Growth performance: Mean height (cm)	Growth performance: No. of new leaves per plant	Flower production: Cumulative total inflorescences
Nov. '80	60.9± 3.5	2.0±0.7	—
Dec. '80	65.5± 3.7	2.0±0.7	—
Jan. '81	68.2± 4.1	5.1±1.1	17± 0.2
Feb. '81	71.3± 5.0	8.2±1.5	39± 3.0
Mar. '81	75.4± 4.7	10.9±2.3	39± 3.0
Apr. '81	79.1± 7.8	12.8±2.4	429± 6.6
Jun. '81	83.7± 8.9	15.3±3.4	809±12.3
Aug. '81	95.7± 8.0	21.6±2.9	1,091±13.1
Oct. '81	101.8±11.8	28.0±3.5	1,514±14.9
Feb. '82	108.7±12.7	34.9±4.0	2,570±17.2
May '82	122.1±13.1	43.5±3.9	3.270±21.5

± S.D.

Table 2. Large scale flower production of ×*Aranda* Christine cv. "130" under field conditions*.

Month	Flower production (inflorescence/month) 1981	1982	1983
January	3,000	12,901	7,003
February	2,000	5,232	5,181
March	556	12,765	24,123
April	23,259	29,360	24,335
May	5,393	6,370	
June	5,278	40,200	
July	15,067	4,842	
August	5,992	3,830	
September	9,380	3,937	
October	19,137	5,602	
November	9,222	11,647	
December	7,163	25,696	
Total	105,447	162,382	60,645

* Total number of plants were 25,703 and planted in June 1980. Experiment was terminated in May 1983.

of *Aranda* in a relatively large plant population (Table 2.) Planting was done in June 1980. Sizeable flower production was evident only in January 1981. There was 3 major peaks of flowering–April, July and October. For 1982, there appeared to be a slight shift in the peaks–April, June and December. For 1983, a peak in March–April was observed before the experiment terminated. On the average, ×*Aranda* Christine produced 6~7 spikes per plant per year in the 2nd and 3rd years of production.

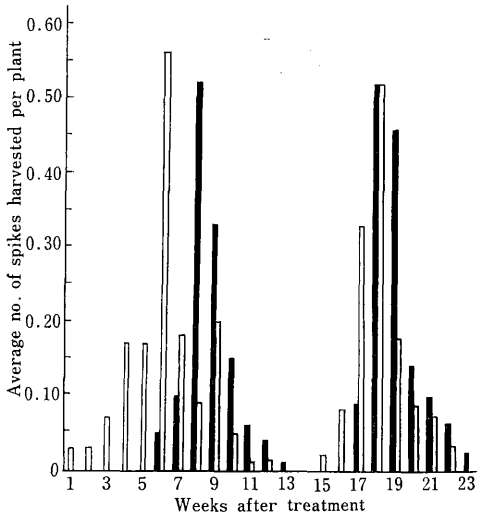

Fig. 1. Number of flowers produced per plant following flower bud removal in ×*Aranda* Christine cv. "130"
■ : Treated □ : Control

Staggering of Flower Production

Figure 1 shows the average number of spikes harvested per plant for the control and the treated. In the control, a peak was observed on the 6th week followed by a decline. A second peak was observed on the 18th week. In the treated, the flower production was evident only on the 6th week after debudding, reachihg a peak on the 8th week. There was a delay of 2 weeks on the subsequent flowering season but the second peak of flowering fell on the 18th week as observed in the control. The total cumulative number of flowers harvested for the control and treated was 1,998 and 1,754 respectively (Table 3). The difference in number of flowers harvested was a result of the removal of flower buds which caused a reduction in flower production immediately after debudding. Subsequent to this, the flower production in the control and the treated was comparable.

The % of flower spikes in various marketable sizes on the 6th week in the control and in treated is presented in Table 4. For the control, the % of large, medium and small spikes on the 6th week was 78.7, 17.6 and 3.7 respectively, whereas in the treated, it was 75.2, 24 and 0.8% respectively. The *Aranda*

Table 3. Cumulative flower production in ×*Aranda* Christine cv. "130" following bud removal.

Month in Cultivation	Cumulative flower production	
	Control	Treated
1	166± 7	33± 4
2	867±18	416±12
3	1,000±20	700±18
4	1,100±38	816±15
5	1,916±38	1,750±40

± S.D.

Table 4. Market quality of *Aranda* flowers harvested on the 6th week after bud removal.

	Inflorescence length (% of total)		
	L	M	S
Control	75.2	24.0	0.8
Treated	78.7	17.6	3.7

Inflorescence length: L=60 cm; M=50~60 cm; S=40~49 cm

flowers showed sign of wilting 8 days after harvest. No significant difference was observed in the longevity of flower in the control and treated scored on the 8th and 10th days.

Discussion

It is interesting to note that the *Aranda* top cutting when planted in the field did not seem to experience a severe shock. There was no apparent lag phase in the plant height increase as the height increment was linear. Being epiphytic in nature, the *Aranda* is well adapted to water stress and carbon conservation. Alternatively, one may argue that the present practice of planting is good and the transplanting shock has been reduced to a minimum.

However, a lag period was evident in the formation of new leaves and flower sprays. The delay in the new leaves production was about 1 month; whereas flowering of the newly planted orchid was evident only after 5 months (Table 1). It might take as long as 1 year before the flower production can become normal as evident from the shifting of the peak of flowering and in the total number of flowers produced (Table 2). Based on the production figures between January and April for the 2nd and 3rd years of planting, it appeared that the flower production in the 2nd and 3 rd years of planting was similar. Hence, replanting of *Aranda* should not be done 3 years after planting as suggested for most monopodial orchids(11). It was rather unfortunate that the experiment was terminated in May 1983 because the land under cultivation had to give way to the construction of a highway. It would be of interest to record flower production for over a period of 4 years. The large population of plants used in the present study would provide reliable information on the seasonability in flowering and productivity of ×*Aranda* Christine. This information will be useful in the forecasting and manipulation of flower production and also for the planting schedule.

×*Aranda* Christine has 3 major flower peaks–April, June and December. By bud removal, one can shift the flower production peak for 2 weeks. These findings could be of interest to orchid growers in ASEAN countries. Through proper staggering, one could ensure adequate supply of good quality cut *Aranda* flowers to coincide with the market demand.

Our results support the observation of Murashige *et al.*(12) that staggering of orchid flower production could be easily brought about by debudding at the right time. In *Vanda* Miss Joaquim, flower yield of control plants declined rapidly from the summer to winter and remained at low level until the following season. Substantial yield increase was observed 2 months after debudding. A greater increase in yield was also observed in present studies but it took place only 4 months after debudding. This had minimised the loss of harvest in the treated. Bud removal did not cause a severe reduction in the total number of flowers harvested. The market quality and longevity of flowers of the control and the treated were comparable. There was an apparent effect of deferment on the flower production as a result of debudding, but no severe damage to the plant was evident. Subsequent flowering behaviour following deferment was normal indicating the effect of debudding is temporary and this is highly desirable. It appears that the debudding is a relatively safe and easy method for staggering flower production in ×*Aranda* Christine cv. "130".

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摘　要

×*Aranda* Christine cv. "130" の熱帯圃場条件下における生長と切花生産に関して研究を行なった.

Aranda の植物体の茎の頂端側 60cm を挿し木し, 同時に定植した. 定植から 18 カ月後までは 1 カ月平均 2～5 枚の葉を形成し, 7 cm の割合で茎が伸長した. 切花の生産は 5 カ月後から開始できた. *Aranda* の切花の生産最盛期は, 4 月, 6 月及び 12 月の 3 回であるが, 花芽の摘除処理により, この時期を 2 週間ずらすことができた. 摘芽処理でも花の特性は正常であり, 摘芽が切花の品質に及ぼす影響はみられなかった.