

CHAPTER 2

Extending flowering period in *Clivia miniata* (Lindley) Regel using a cold treatment

2.1 Summary

Clivia miniata can be forced to flower out of season by applying a cold treatment which brings about emergence and development of quiescent inflorescences. Plants growing outdoors were exposed to a cold treatment of 7.5 -10 °C for 14 days, commencing during the last week of April. This caused a significant number of the cold treated plants to flower earlier in the season. The implication was that the period during which *Clivia* in flower was available for sale could be extended. The difference between the number of cold treated and control plants in flower was most noticeable in the period from 12 - 19 weeks after commencement of the cold treatment. The 14 day period of cold treatment which was required for successful forcing under local conditions was shorter than a period of 60 days previously described.

2.2 Introduction

Flower forcing is undertaken in many species in order to prolong the period in which plants are in flower or to have plants in flower for specific occasions (De Hertogh *et al.*, 1997). *Hippeastrum* sp. is an example of the Amaryllidaceae which can be successfully forced (Sandler-Ziv *et al.*, 1997). It has been shown that *Clivia miniata* can be brought into flower outside its natural flowering period by manipulating growing temperature (Mori & Sakanishi, 1974, Vissers & Haleydt, 1994, De Smedt, Van Huylenbroeck & Debergh, 1996). *Clivia* has a modular, sympodial growth form and inflorescences form terminally on modules (Chapter 5 of this dissertation). Modules are produced as two or more recurrent flushes per growing season, depending on cultural conditions. Inflorescences remain quiescent until a cold stimulus is received which stimulates elongation of the peduncle and further development of the inflorescence. It appears that the inflorescence is only able to respond to the cold stimulus once it has reached a minimum size and it is known that flower initiation is linked to the production of a certain number of leaves (De Smedt *et al.*, 1996). In South African production of *Clivia*, there is usually no control of growing temperature and flowering occurs mainly from August to September. The aim of this experiment was to determine whether a cold treatment could bring plants grown outdoors into flower earlier. It was hoped that this would extend the naturally short flowering period and ultimately increase sales and revenue to *Clivia* growers.

2.3 Materials and methods

The trial was conducted in the east of Pretoria at a nursery situated on the north facing slope of a hill where *Clivia* is grown under 70% black shade net. The experiment comprised 100 mature plants with at least 12 mature (fully elongated) leaves on each plant. Plants were growing in 6 liter plastic bags. Fifty randomly selected plants were removed from the nursery for the cold treatment and 50 plants remained as the control. The cold treatment comprised placing plants with plastic bags intact, in a dark, unventilated cold room for 14 days. The temperature was maintained between 7.5 and 10 °C and oscillated from minimum - maximum - minimum every 4 hours. The period of cold treatment was chosen after exploratory investigations indicated that 14 days was sufficient to bring plants into flower. This is in contrast to a period of 60 days at 10 °C previously described for successful forcing of *Clivia* (Mori & Sakanishi, 1974). After the cold treatment, plants were returned to the nursery. At weekly intervals, the number of plants which had reached the marketable stage was recorded for both treatments. A plant was defined as marketable when it had a normally elongated peduncle with some orange colouration in the perianth, but before any flowers were open. The air temperature in the nursery, at leaf canopy level, was recorded for the duration of the experiment using a thermograph which had been calibrated with a mercury thermometer. A Chi square test was used for the statistical analysis and required data from weekly observations to be combined into fortnightly data. The number of observations at each fortnightly interval was large enough for analysis only from week 12 onwards. A two way table of the two treatments versus time for the four fortnightly periods (effective sample size = 87) was used to test the null hypothesis which proposed that there was no relationship between treatment and time.

2.4 Results and discussion

Figure 2.1 shows the weekly minimum and maximum air temperatures in the nursery for the duration of the experiment from 24 April 2000 (week 0) to 04 September 2000 (week 19). It is apparent that maximum temperatures fluctuated between 16 and 27 ° C and minimum temperatures between 2 and 11 °C. After the cold treatment, it could be seen that cold treated plants flowered earlier than controls and that there were no negative effects following storage in the dark. Figure 2.2 shows on a weekly basis, over 19 weeks, the percentage of plants in each of the two treatments which had reached the marketable stage. Figure 2.3 (combined data) shows the percentage of plants in each treatment which had reached the marketable stage for the four fortnightly periods from week 12 - 19. The number of plants at marketable stage was

equal to zero until and including week 6. After 19 weeks, 96% of cold treated plants and 94% of controls had flowered, but Figure 2 and 3 indicate the trend whereby cold treated plants flowered before controls. Table 2.1 is the two way table of treatment versus time and shows the observed and expected values from the Chi square test for cold treated and control plants ($P < 0.0001$). It indicates that for the first two fortnightly periods (week 12 - 13 & 14 - 15), the number of cold treated plants which were marketable, was significantly higher than expected while in the control treatment the number was significantly lower than expected. Conversely, during the last two periods (week 16 - 17 & 18 - 19), the number of plants at the marketable stage was significantly lower than expected for cold treated plants and significantly higher for controls. This result allowed rejection of the null hypothesis and it was concluded that the cold treatment was effective in increasing the number of plants available for sale early in the season when control plants were not marketable yet. It can therefore be deduced that one will be able to extend the period during which *Clivia* is available in flower by applying a cold treatment of relatively short duration, as described, to a portion of plants intended for sale in a specific season.

Prior to the abovementioned experiment, two exploratory investigations were carried out. In the first, a similar cold treatment was applied to outdoor grown plants at the beginning of February and flowering occurred in March and April. In the second, flowering size plants were placed in a greenhouse which was heated from the beginning of April to the end of August so that exposure to winter cold was eliminated. These plants did not flower during the natural flowering period when plants outside were in flower. A cold treatment was then applied at the end of November and brought some of the plants into flower in January and February. Therefore, it is felt that it may be possible to even further extend the flowering period in *Clivia*. However, these results could not be statistically tested and will need to be verified.

Further work could try to find out whether a cold treatment can be effectively applied earlier or later than the last week in April. The earliest and latest dates for successful forcing could also be determined. The phenomenon of negation of the effect of a cold treatment when followed by high growing temperature can also be investigated.

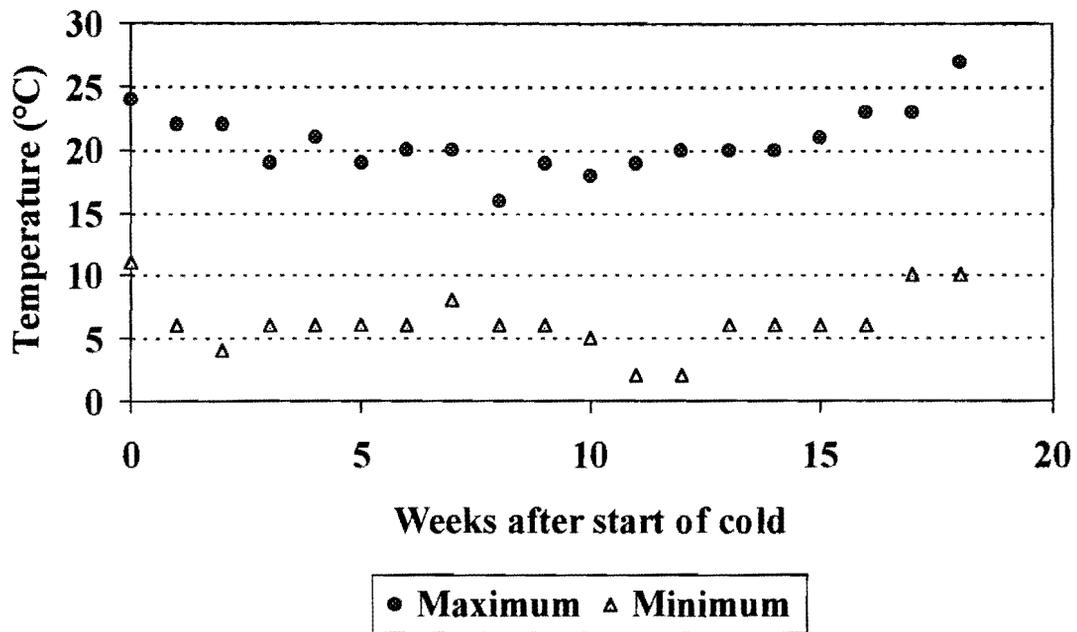


Figure 2.1 Weekly minimum and maximum air temperatures at leaf canopy level from week 0 - 19.

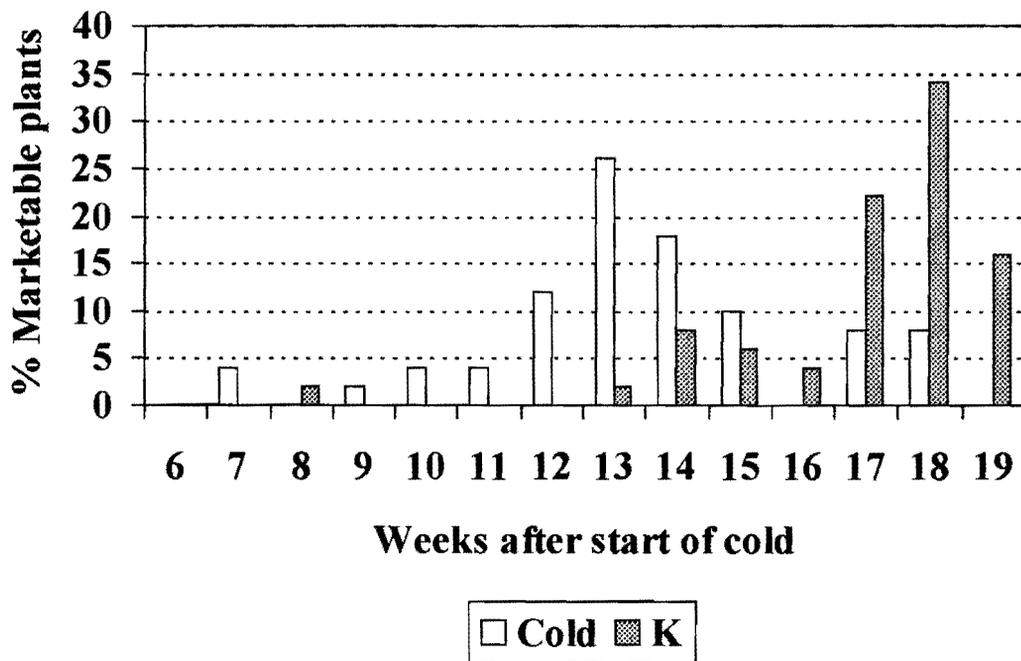


Figure 2.2 Percentage of plants at the marketable stage from week 6 - 19.

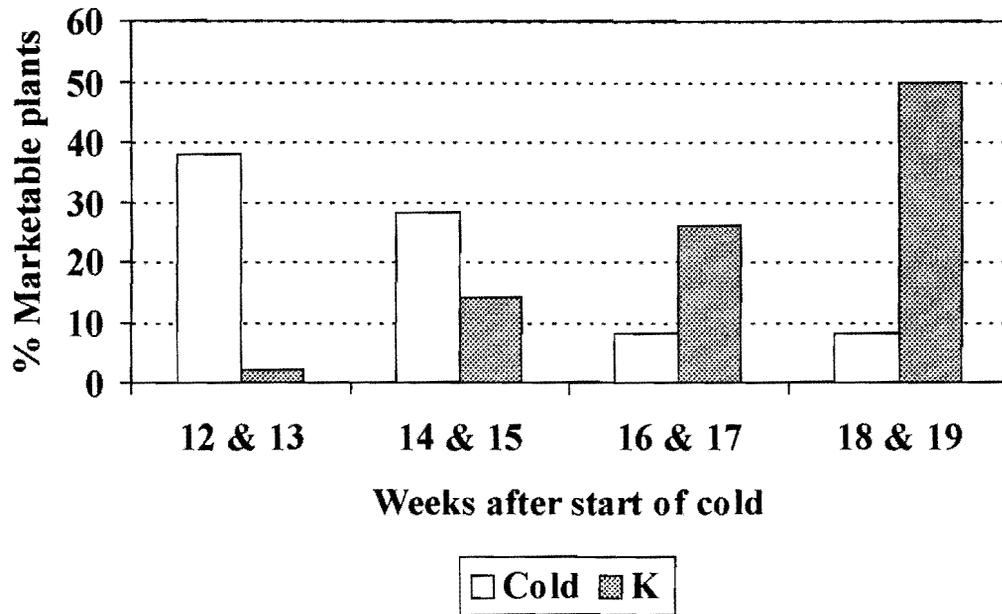


Figure 2.3 Percentage of plants at the marketable stage for the four fortnightly periods from week 12 - 19.

Table 2.1 Two way table of treatment versus time with observed and expected () values for cold treated (Cold) and control (K) plants. Expected values were obtained from a Chi square test ($P < 0.0001$) Effective sample size = 87.

Treatment	Week			
	12 & 13	14 & 15	16 & 17	18 & 19
Cold	19 (9)	14 (10)	4 (8)	4 (14)
K	1 (11)	7 (11)	13 (9)	25 (15)

2.5 References

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