YEAR-ROUND PRODUCTION OF EUCHARIS FLOWERS

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Abstract

Dry bulbs of *Eucharis grandiflora* Planch. et Lind., 19 to 44 mm in diameter, were planted. After 1 year the 19 mm bulbs had grown to 34 mm, the 44 mm bulbs to 48 mm. Flowering plants were obtained after treatment at 27°C. A duration of 2, 3, 4 or 5 weeks at 27°C resulted in 20, 75, 85 and 85% flowering plants, respectively. No plants flowered after 1 week at 27°C. A 27°C treatment given to plants with bulb diameters of 19, 22 or 26 mm did not result in flowering. With bulb diameters of 29, 32 or 35 mm, however, 29, 76 and 90% of the plants flowered.
Leafy *Eucharis* plants, with bulb diameters of 35 mm or more, flowered 3 months after the end of a treatment at 27°C given during 4 weeks. The flowerstems were cut and a second treatment was given. The plants flowered again, 3 months after the end of this treatment. Forty dry bulbs were planted on a surface of 37 x 47 cm (styrofoam cucumber box). The plants were treated at 27°C when 80% of the bulbs had 2 full-grown leaves and 20% had 1 leaf. The plants flowered 212 days after the dry bulbs had been planted. They flowered again 4 months later, after another 27°C treatment.

Introduction

Eucharis grandiflora Planch. et Lind. (*Amaryllidaceae*) has been grown commercially for over 100 years. In the Netherlands, bulbs are planted in the glasshouse in heated bottom beds where the plants remain for periods of up to 4 years. Plant density then has so much increased - a result of the formation of side bulbs - that renewal of the beds is required. Bulbs are lifted, the foliage is removed and newly formed bulbs are separated from the original ones. They are then air-dried and can be replanted. The plants always have leaves. In summer they are grown at prevailing temperatures, and shading is provided to prevent leaf burn. In winter, soil and air temperature are kept at a minimum of 15-17°C. Under these conditions, a bottom bed with about 3000 bulbs will produce an occasional flower throughout the year. In September/October, and also in March/April, about 10-20% of the plants flower. Unfortunately, nothing is known about growth and flowering of the individual plants in such bottom beds.
Thusfar, commercial production of *Eucharis* is rather limited. This is not surprising: the plant takes a permanent place in the glasshouse, requires rather high temperatures and its flowering is not programmed. Baily (1917) states that the plants will flower if kept dry until near wilting for a period of 1 month and then thoroughly soaked in water. Lindstrøm (1971) suggested that flowering of *Eucharis* was promoted when water and bottom heat were withheld during a resting period, followed by watering and bottom heat during the growing period. Adams and Urdahl (1971 and 1973) used leafy potted plants growing in a glasshouse at 18.3°C. They found that 21 days at 19.4°C or 12 days at 29.4°C

were required for flower induction. Time after heating to opening of first flower was 70-95 days. Deba and Meyers (1973) mentioned that the shortest treatment which gives a high percentage of flowering plants was 3 weeks at 29.4°C. Carow (1977) using the data obtained by Lindstrøm (1971) and by Adams and Urdahl (1971 and 1973) concluded that Eucharis, like other Amaryllidaceae (Nerine, Hippeastrum) has 2 flowers per bulb, one of which emerges after the heating period. In this paper we present an outline for the programming of growth and flowering of *Eucharis*, which may be useful for the year-round production of flowers.

Plant material

For the first experiments we used dry bulbs from a commercial grower. For the further experiments we used potted leafy plants obtained through the in vitro culture of bulb scales from commercially available bulbs (Pierik et al., 1983).
There was no difference between the plants of these two sources. This included their reactions to the treatments.

Methods

Dry bulbs were planted in the soil of the glasshouse, or in 2.7 L plastic buckets. Others were planted in soil in styrofoam (cucumber) boxes, inside dimensions 37 x 47 x 15 cm (depth). Forty bulbs were planted in 1 box. All plants were grown in a mixture, by volume, of 3 'Naturado' (a commercially available ready mixture for pot plants), 1 cow manure and 1 clay. Soil temperature was 20°C, air temperature 22°C (day) or 19°C (night). Heat treatment was given to the potted plants and to the plants in the styrofoam boxes. Based on the work of Adams and Urdahl (1971 and 1973) a temperature of 27°C was chosen for this treatment. Plants were transported to a growth cabinet at 27°C, which raised the temperature around the bulbs to 26°C. Plants were illuminated, 16 hours per day, with Philips ML 160 lamps giving 3 W m^{-2} at 40 cm above soil, that is at leaf canopy height. After the 27°C treatment plants were transferred back to the glasshouse.

Bulb growth

On February 9, 1981, the diameters of dry bulbs were measured and the bulbs planted in the soil of the glasshouse. After one year, bulb diameter, numbers of leaves and side bulbs were recorded.

Minimum bulb diameter required for flowering

Potted leafy plants obtained through in vitro culture were used. Bulb diameter was measured in situ. Plants were exposed to 27°C for 4 weeks, then transferred back to the glasshouse. The number of flowering plants was recorded.

Minimum duration of the 27°C treatment required for flowering

Dry bulbs of 35 mm diameter or more were planted in pots. After 8 months the leafy plants were exposed to 27°C for periods of 0, 1, 2, 3, 4 or 5 weeks, then transferred back to the glasshouse. Number of flowering plants and time from transfer to flowering were recorded. For a given treatment flowering date was recorded when 50% of the

flower bearing plants had the first flower open.

Repeated flowering

Potted leafy plants with bulb diameter of 35 mm or more were exposed to 27°C for 4 weeks. Flowering of individual plants was recorded. The flower stems were cut at flowering time. The plants were then immediately exposed again to 27°C for 4 weeks. The effect of this treatment on flowering was also recorded.

Flowering of densely planted bulbs

The styrofoam boxes with 40 dry bulbs planted in the inside area of 37 x 47 cm were dug in the soil of the glasshouse. Eighty percent of the bulbs had 2 fully developed leaves, 20% had 1 leaf, 105 days after the dry bulbs were planted. At that time the boxes with the plants were exposed to 27°C for 4 weeks, and again after the flowers of the first flowering had been cut. The flowering was recorded.

Results

Bulb growth

One year after the dry bulb had been planted, the diameter of the originally smaller bulbs had increased more than the diameter of the originally bigger bulbs (Table 1). The number of side bulbs increased with increasing bulb size. The number of leaves formed after 1 year was about the same, irrespective of the original bulb diameter.

Table 1 - Diameter of dry *Eucharis* bulbs at the time of planting. Diameter, numbers of leaves and side bulbs after 1 year of growth.

Number of planted bulbs	18	91	98	140	200	229	102	50	11
Diameter (mm) of dry bulbs planted	19	22	26	29	32	35	38	41	44
Diameter (mm) after 1 year growth	34	35	36	40	40	44	44	45	48
Number of side bulbs/plant	1.4	1.5	1.9	2.0	2.3	2.8	2.8	3.1	3.4
Number of leaves/ plant	4.7	4.7	4.5	4.5	4.6	4.7	4.7	4.6	4.7

Minimum bulb diameter required for flowering

Table 2 shows that the percentage of flowering plants increased from 0 (bulb diameter 26 mm or less) to 90 in plants with bulbs of 35 mm.

Table 2 - Bulb diameter of plants just before treatment at 27°C. Percentage of flowering plants.

Bulb diameter (mm) before 27°C treatment	Number of plants	Flowering %
19	3	0
22	7	0
26	24	0
29	28	29
32	41	76
35	20	90

Minimum duration of 27°C treatment required for flowering

The highest percentage of flowering plants was recorded after treatment at 27°C for 4 weeks (Table 3). The number of days from the end of the treatment until flowering was not affected by the duration of the treatment.

Table 3 - Number of weeks of 27°C treatment, percentage of flowering plants, number of days from the end of the treatment until flowering.

Number of weeks at 27°C	Flowering plants (%) (n = 20)	Days from end of 27°C treatment until flowering
0	0	-
1	0	-
2	20	98
3	75	95
4	85	99
5	85	94

Repeated flowering

Table 4 shows that plants which have been flowering as a result of a 27°C treatment, can be brought to flowering again by a second 27°C treatment. In a given group of plants, however, some plants flower only after the first 27°C treatment, others only after the second. Thus, 64 + 18 = 82% of the plants flowered after the first 27°C treatment and 64 + 15 = 79% after the subsequent treatment. There were 126 days between the two flowering dates (28 days at 27°C and 98 days more until flowering).

Table 4 - Repeated flowering in a group of 92 plants.

Flowering after the first and also after the second 27°C treatment	64%
Flowering after the first 27°C treatment	18%
Flowering after the second 27°C treatment	15%
Not flowering	3%

Flowering of densely planted bulbs

Eighty-seven percent of the plants flowered after the first 27°C treatment (Fig. 1), 65% after the second. It took 105 days before 80% of the dry planted bulbs had 2 leaves and 20% one leaf. At that time the 4 weeks 27°C treatment started. Plants flowered for the first time 86 days after this treatment. Thus it took 105 + 28 + 86 = 219 days from planting dry bulbs until first flowering. It took 4 weeks at 27°C plus 92 days until the plants flowered again. That is 28 + 92 = 120 days from the first flowering until the next.

Discussion

Our results confirm the observation of Adams and Urdahl (1971 and 1973) that high temperature treatment results in flowering of *Eucharis*. Flowering of *Eucharis* in September/October, when growing under prevailing conditions in the greenhouse, is most probably the result of high temperatures during the preceding summer. The flowering in March/April comes after the low winter temperatures and it remains to be investigated if these were the cause of flowering. We are, however, aware of the possibility that flowering of *Eucharis* is not primarily the result of applied low or high temperatures, but the result of the reaction of the plant to a sudden and prolonged (2 weeks, 4 weeks?) period of exposure to a temperature higher or lower than the prevailing one.

Lindstrøm (1971) concluded that *Eucharis* requires a resting period before flowering can be induced. Deba and Meyers (1973) concluded that *Eucharis* bulbs have a growing point which may develop into a flower, with the subsequent development of a lateral bud taking over the new growing point. They found that a 28-day minimum rest period was optimum from last flower removal to initiation of a new flowering cycle, but not because of anatomical deficiencies in the growing point (lateral bud). Our observation that a 27°C treatment is effective when started at the time of flowering does not confirm these conclusions. Our results showing that *Eucharis* when densely planted in boxes can flower repeatedly after short treatments at 27°C opens perspectives for applications in the practive of horticulture, if year-round production of flowers is desired.

References

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Fig. 1. Densely planted *Eucharis grandiflora* Planch. et Lind. flowering 3 months after the end of a 4 week period at 27°C.