GROWTH AND FLOWERING OF *Anemone coronaria* L. 'de Caen'

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Abstract

Corms which were harvested in late June and immediately dried and stored at room temperature were replanted from July to November and maintained at 0°, 5°, 10°, 15°, 20° C.

Regardless of the planting date or temperature, all corms emerged. The 20° C treated corms emerged the earliest, followed by 15°, 10°, 5° and 0° C. The 4 weeks 5° C corm treatment resulted in 100 % floral primordia development 4 weeks after planting. Initiation of floral primordia with non-cold corms was slower than with the cooled corms and consequently anthesis was delayed by 30 days. Regardless of cold treatment,days to anthesis were shortest at 20° C, followed by 15°, 10°and 5° C. Flowers number per plant and stem length was highest at 10° C, but flower weight and stem diameter were best at 5° C. Photoperiod treatments were not significant, although long day did hastened flowering. Low temperature forcing treatment from a practical view point, is valid as when low temperature treatment began in August, the 10° C 4 weeks treatment was optimum for rapid flowering, high number flower, flower weight, stem diameter for production from October to February.

1.Introduction

Anemone coronaria L.'de Caen' is popular cut flower from late winter to early spring in Japan. Commercially *Anemone coronaria* L.'de Caen' seeds are sown in early October in southern Japan. Two weeks later seeds germinate and are grown from autumn to early summer. Corms which subsequently developed are harvested in middle June and keep dry until early August. In August corms cold treatment commence. The production span for flowering is from early November to early April. The selection of 'de Caen' have been conducted for a long time. And more recently, the flower color has became stable with blue, scarlet, pink and white available. The average stem length is 40-50 cm and the number flowers per plant are 13-15. It is possible to produce this crop in unheated plastic covered house along the Pacific coastline regions.

Very little literature concerning corm dormancy, and temperature effects and daylength have been reported for *Anemone coronaria* L.. These experiments were undertaken to determine corm dormancy, temperature and daylength response and the most effective forcing temperature for this Anemone species.

2. Materials and methods

Anemone coronaria L.'de Caen'blue was used in all the experiments described.

2.1. Experiment 1. Relation between depth of dormancy and temperature on shoot emergence and elongation from Anemone corms

Corms were harvested in June, 1983 by a commercial firm and received in early July and stored at ambient air temperature(figure 3). On 20 July, August, September, October or November, respectively, corms were placed in moist perlite for one day. After this, corms were placed in rooms where the temperature were controlled at 0°, 5°, 10°, 15° and 20° C until 100 % corms emergence. Days to shoot emergence and shoot length were recorded. The average weight of dried corms was 1.04 ± 0.17 g, and 50 corms were used for each temperature treatment.

2.2. Experiment 2. Floral initiation and development

Dried corms were obtained in July, 1984 and were again stored at ambient, hydrated as above and cold treatment for 0 or 28 days at 5° C, which commenced on 27 September. Control and cold treated corms were planted in the greenhouse where night temperature were 10 ± 1° C. Day temperature averaged 25° C. Floral initiation development were checked weekly.

2.3. Experiment 3. Photoperiod influences on the vegetative and floral development

Corms used were similar to Experiment 2. Corms were stored in ambient until 12 October. Non-cooled corms were hydrated as described and planted in a greenhouse with a 10° C ± 1° C night temperature. At shoot emerged plants were given on 8-hour short day(black cloth from 16.30-8.30), long day(incandescent 150 lux night interruption from 22.00 -2.00) or natural day(figure 4). Data that were taken are shown in table 2.

Corms were obtained on August 1985 and stored at ambient. From 28 October to 25 November 1985, corms were given 5° C cold treatment for 28 days after they had been hydrated as described. After cold treatment corms were planted in the greenhouse, with night temperature of 10° ± 1° C or 20° ± 1° C. Growth characteristics were recorded(table 3).

2.4. Experiment 4. Effect of cold treatment and growing temperature

Corms of 'de Caen' were obtained 17 July,1983 and were stored at ambient temperature and hydrated as above. Cold treatment(5° C-28 days) commenced on 21 September. Control and cold treated bulbs were planted 18 November in 5°, 10°, 15° and 20° C night temperature greenhouse. Days to anthesis, flower numbers per plant, stem length and weight were recorded until 30 April.

2.5. Experiment 5. Influence of cold temperature treatments for forcing on growth and flowering capacities

To investigate optimum cold treatment required for rapid forcing, corms were obtained 17 July,1985. Bulbs were stored in ambient and hydrated as described. The 4 weeks cold treatment commenced on 1 August or on 14 August,1985 (table 4). Corms were planted in to the greenhouse in 28 August,1985 or on 11 September,1985. Night temperatures were between 8 to 10° C. Thirty corms were used to each treatment.

3. Results

3.1. Experiment 1. Relation between depth of dormancy and temperature on shoot emergence and elongation from Anemone corms

All corms emerged regardless of temperature treatment or date of treated(figure 1). Higher the temperature treatment, shoot emergence was more rapid for the respective treatment dates. Higher the temperature treatment, longer the shoot length(figure 2). These data suggest that *Anemone coronaria* L.'de Caen' does not have a qualitative low temperature requirement. Data indicates that a 0° C temperature treatment is too low for dormancy release as shoot emerged after 2 month and shoot growth was very slow.

3.2. Experiment 2. Floral initiation and development

Floral initiation was first indicated by the differentiation of 3 to 5 irregular pubescent bracts. Next, 8 to 9 normal shaped petals were initiated, followed by numerous stamens and the finally the pistil. Flower initiation and development was hastened by the 5° C temperature treatment when compared to the control(table 1). Days to flower for the cold treatment corms was 62.3 $\pm$ 5.2 days versus 93.0 $\pm$ 5.4 days for the non-treated corms. Occasionally, flower initiation of *Anemone coronaria* L.'de Caen' commenced during the very early growth stage, namely flower initiation occurs without open leaves.

3.3. Experiment 3. Photoperiod influences on the vegetative and floral development

All plants flowered irrespective of photoperiod(table 2 and 3). Night interruption treatment hastened flowering by some 7 to 10 days and short days delayed flowering by 5 days when compared to the natural day treatment. *Anemone coronaria* L.'de Caen' is apparently a qualitative long day plant. Scape elongation did increase under long days(table 3). However, photoperiod influence on the flowering was not so impactive as with *Ranunculus asiaticus* L.(Ohkawa, 1986).

3.4. Experiment 4. Effect of cold treatment and growing temperature

Days to flower were reduced when plants were grown at 20° C night temperature and when plants were grown 5° C night temperature, days to flower increased(figure 5). The flower yield and shoot length were greatest when grown at 10° C night temperature(figure 6 and 7). Flower weight and stem diameter were greatest at 5° C night temperature(figure 8 and 9). Flower numbers and quality of the cold treatment corms were inferior to non-cold treatment corms, regardless of forcing temperature.

3.5. Experiment 5. Influence of cold temperature treatment for forcing on growth and flowering capacities

Shoot elongation occurred during treatment at 20° C and 15° C. Shoot length at 10° C were 1.2 cm and 5.9 cm (table 4). Days to flower, flower number, weight, stem length and stem diameter were superior when stored at 10° C. Flower production from October to February was 50 % of total number of flower irrespective of temperature of cold treatment(table 4).

4. Discussion

Anemone coronaria L. has been grown more than 400 years in the world. These data indicate that *Anemone coronaria* L. corms do not require a cold temperature for shoot emergence or flowering. Even at 20° C treated corms sprouted and flowered(figure 1 and 5). Low temperature corm treatments did hasten flowering, although flower quality was slightly inferior to the non-treated ones(figure 7,8 and 9). From the view point of harvested flower numbers and quality, 10° C corm temperature treatment was optimum. Greenhouse night temperature higher than 10° C decreased flower numbers and quality. Using selection of'de Caen', Jones(1986) also reported shoot emergence from corms maintained at 9°, 12°, 15° and 18° C promoted at highest temperature.

Anthesis of'de Caen' was slightly hastened by night interruption and short day tends to retard anthesis. Data support that *Anemone coronaria* L.'de Caen' should be considered a qualitative long day plant. However, night interruption treatments are not commercially practical in Japan.

Kadman-Zahavi et al., (1984), from Israel, reported varied long day influence on flowering in Anemone. They reported that in some strain, flowering was delayed and reduced, but the cv.'Mr Fokker' flowering was hastened with 100 % flowering. With'de Caen', which was used in this experiment responded similarly to 'Mr Fokker'. Under conditions in Israel, even during mid-winter, new leaves differentiation and flowering ceased earlier under long day treatment than under natural day length. This phenomenon was induced by the root dormancy. These phenomenon was not observed in this experiment(table 2).

References

Horovitz, A., 1985. *Anemone coronaria* and related species. Handbook of flowering Vol 1:455-464. Ed.A.H.Halevy,CRC Press,Boca Raton, Florida U.S.A.

Ohkawa, K., 1986. Growth and flowering of *Ranunculus asiaticus* L. Acta Horticulturae 177:

Jones, S.K.,1986. The germination of Anemone'St.Piran seed and corms. Acta Horticulturae 177:

Kadman-Zahavi, A., 1984. Long day induced dormancy in *Anemone coronaria* L. Annals of Botany 53:213-217.

Table 1 - Flower initiation and development.

Number of weeks after plant	Cold treatment	Unfolding leaves	Plant height (cm)	Differentiated leaves	Initiation and development of 1 st flower					
					1	2	3	4	5	6 z)
4	yes	2.3±0.7	6.0±1.8	4.5±1.7		1	2	7 y)		
	no	2.7±0.9	7.0±3.3	5.5±1.0	1	4	3	2		
6	yes	3.5±1.6	11.1±3.6	5.3±1.6			1	5	4	
	no	3.8±1.0	11.3±3.0	5.8±1.0		4	3	3		
8	yes	4.3±1.3	11.5±2.2	6.1±0.9					10	
	no	4.9±1.6	13.2±2.0	7.0±1.1			4	6		
10	yes	5.9±3.0	12.0±1.0	7.8±2.5						10
	no	6.9±1.7	16.0±2.5	8.7±2.1				3	7	

z)1.Non-differentiation 2.Bract differentiation 3.Petal differentiation 4.Stamen differentiation 5.Pistil differentiation 6.Anthesis y) Each treatment 10 corms used

Table 2 - Effect of day length on the growth and flowering (non-cold treated corms)

Day length	Days to flower	Number of flowers	Stem length (cm)	Flower weight (g)	Harvesting ratio (%)		
					Jan	Feb	Mar
Long	115.9±15.7	6.3±3.8	34.2±6.6	5.1±1.2	8	31	61
Natural	122.8±23.1	5.8±2.3	33.3±4.9	4.1±1.3	6	25	69
Short	127.6±19.2	4.9±2.3	32.3±7.7	5.2±1.3	9	23	68

Table 3 - Effect of day length on the growth and flowering (5°C - 28 days cold treated corms)

Night temperature	Day length	Days to flower	Flower numbers per plant	Stem length (cm)	Flower weight (g)
10°C	Long	63.4±10.3	4.6±2.4	23.1±6.0	3.6±1.4
	Natural	73.1±11.1	5.0±2.0	22.0±5.4	4.0±1.3
20°C	Long	60.5±16.0	3.0±1.5	27.0±7.7	3.4±1.4
	Natural	70.8±19.1	4.0±1.1	21.8±5.5	2.7±1.1

Table 4 - Effect of cold treatment on the shoot length and harvesting ratio.

Date of cold treatment commenced	Cold treatment temperature °C (4 weeks)	Shoot length at end of cold treatment (cm)	Harvesting ratio %		
			Oct-Dec	Jan-Feb	Mar
1 August	20	21.2	9.8	43.8	46.4
	15	15.6	13.2	37.4	49.4
	10	1.2	11.8	42.6	45.6
	5	0.1	11.3	40.3	48.4
	10°C 2 weeks +5°C 2 weeks	0.1	9.5	44.6	45.9
	10°C 2 weeks +0°C 2 weeks	0.1	8.9	37.7	53.4
14 August	20	21.3	9.5	45.8	44.7
	15	18.9	9.3	39.9	50.8
	10	5.9	17.8	43.0	39.2
	5	0.3	16.0	40.7	43.3
	10°C 2 weeks +5°C 2 weeks	1.4	12.8	43.8	43.4
	10°C 2 weeks +0°C 2 weeks	0.6	10.8	38.5	50.7

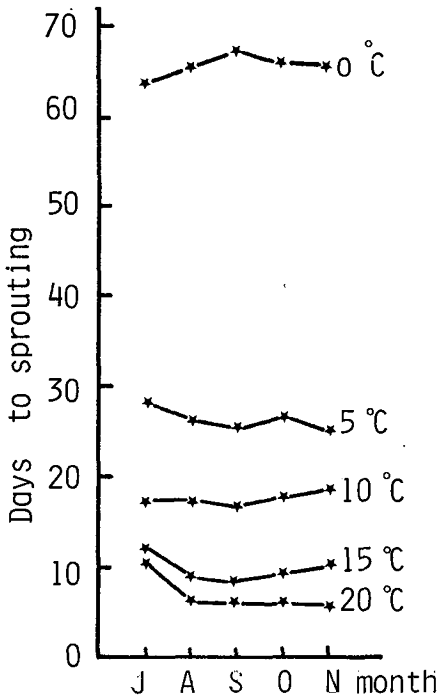

Figure 1 - Relation between depth of dormancy and temperature for sprouting.

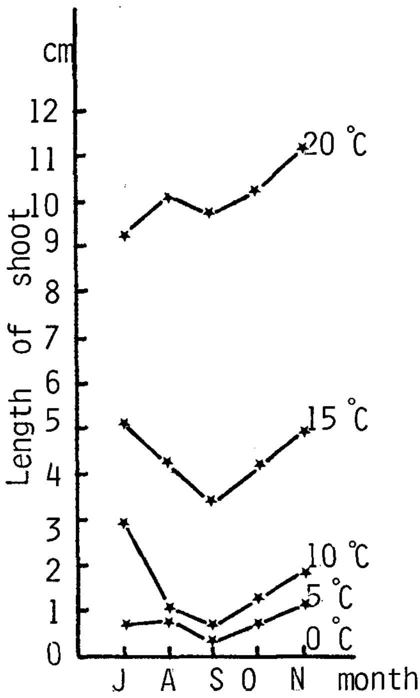

Figure 2 - Length of shoot 4 weeks after planting.

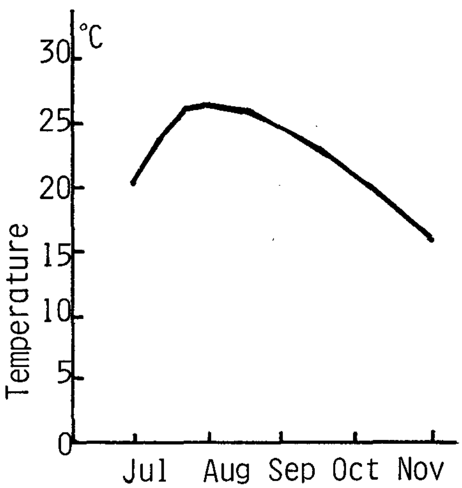

Figure 3 - Ambient air temperature during dried corm storage.

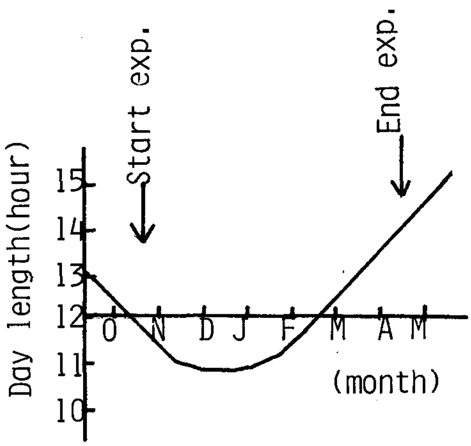

Figure 4- Natural day length during experiment(Twilight morning and evening included)

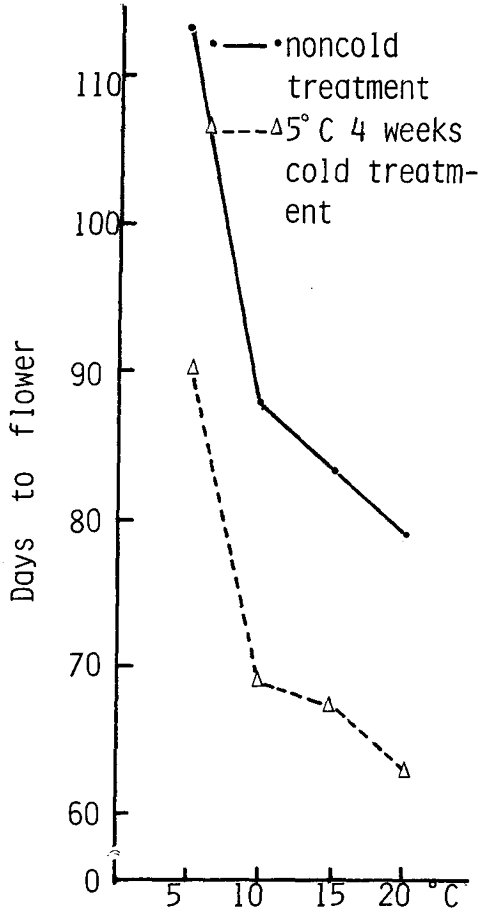

Figure 5 - Days to flower.

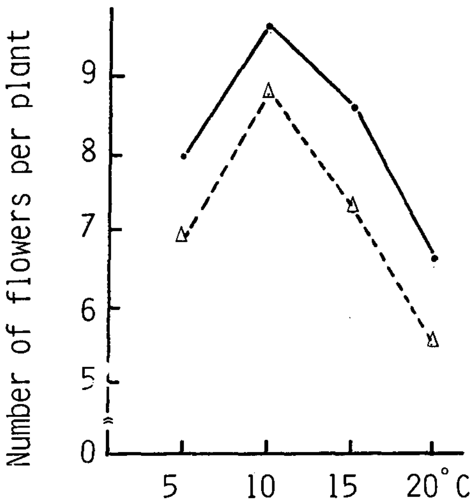

Figure 6 - Number of flowers.

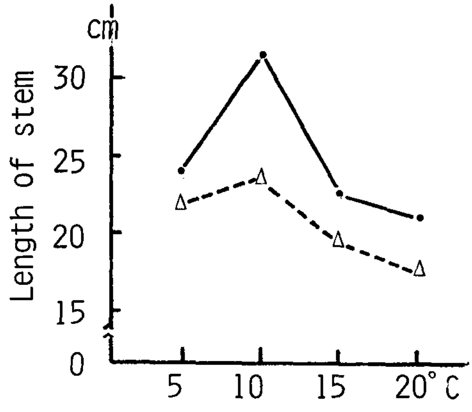

Figure 7 - Stem length.

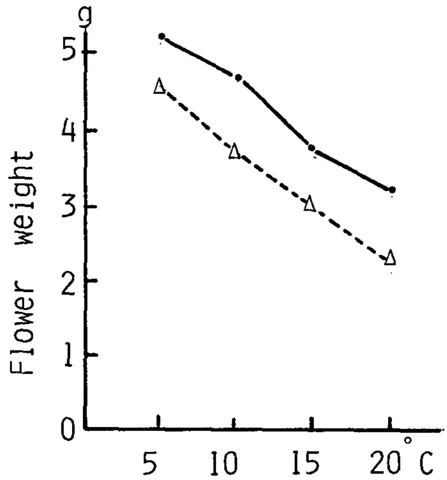

Figure 8 - Flower weight.

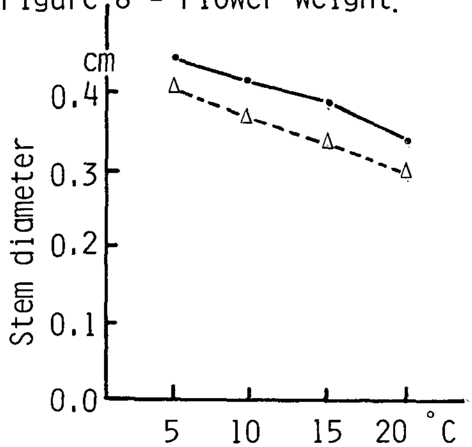

Figure 9 - Stem diameter.

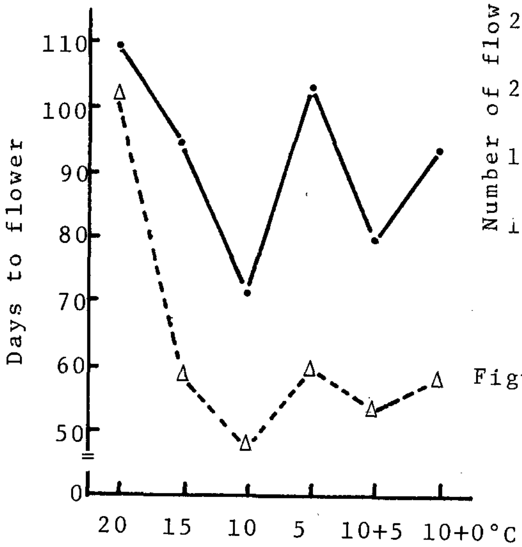

Figure 10 - Effect of cold treatment temperature on the days to flower.

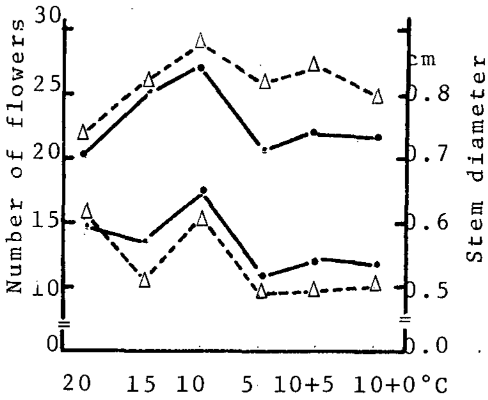

Figure 11 - Effect of cold treatment temperature on the number of flowers and stem diameter.

•——• 1 August cold treatment commence

Δ----Δ 14 August cold treatment commence

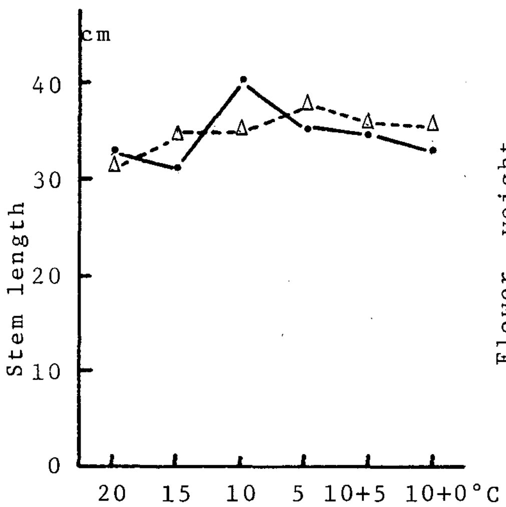

Figure 12 - Effect of cold treatment temperature on the stem length.

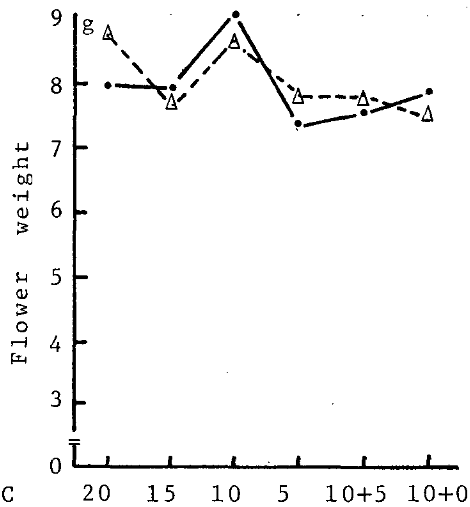

Figure 13 - Effect of cold treatment temperature on the flower weight.