treatment except with a triple application of 1000 ppm that caused bud abortion. Date of flowering was not affected by treatments of less than 500 ppm. At this concentration time of flowering was related to number of applications with about 4 days delay on plants receiving 3 applications.

Stems which received no PBA were dead at the time of bulbil harvest but those receiving PBA showed increasing amounts of green color in direct relationship to the amount of PBA applied.

These results suggest that bulbil induction by PBA might be used for Easter lily propagation.

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Differences in Chilling Effects on Shoot Emergence from the Bulb and on Leaf Emergence from the Scale Bulblet in *Lilium longiflorum* Thunb.[1]

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Additional index words. cold treatment, scale propagation

Abstract. **Shoot emergence from the bulb was promoted, while leaf emergence from the scale bulblet was retarded as the chilling duration of bulbs was increased from 0 to 5 weeks prior to planting or to scale propagation.**

Cold treatments promote shoot emergence in *Lilium* and have been used as a programming technique in forcing. If bulb cold treatment prior to scaling would likewise promote early leaf development from the resulting new scale bulblets, this technique might be used in commercial scale propagation to increase photosynthetic surface, net assimilation, and movement of substrate from the parent scale to the newly developing bulblet (2). This experiment was designed to study the influence of bulb cold treatment prior to scale propagation on leaf development from new scale bublets.

Bulbs of 'Hinomoto' (14 - 15 cm in circumference) produced on the island of Okino-erabu (27°N latitude), Kagoshima Prefecture, Japan, were received in Kagoshima City on July 12, 1977, and stored at 25°C in the dark. On August 8, 1977, they were soaked in 45°C water for 30 min. After drying, the bulbs were soaked in 1% Benlate for 30 min prior to dark storing at 10° and/or 25°C.

After the storage of 35 days, the outer and middle scales were removed (1) (Fig. 1) and the outer scales discarded. The detached middle scales and the bulb cores consisting of the inner scales still attached to the basal plate, were used in this experiment. Both were planted out of doors 3 cm below the soil surface in wooden boxes filled with a mixture of 1 sand :1 loam. The boxes were covered with a sheet of cheese cloth. No nutrients were applied. From 26 to 28 bulb cores and from 152 to 230 scales were used for each treatment. The number of emerging shoots and the number of scale bulblets with developing leaves was determined weekly. Leaf emergence was expressed as the percentage of bulbs or scale bulblets having initiated shoots and/or leaves. The experiment was terminated on January 7, 1978 for bulb shoot emergence and on April 22, 1978 for scale bulblet foliation.

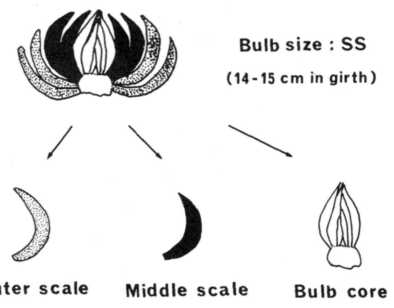

Fig. 1. Collection of middle scales and the remaining bulb used for the experiment.

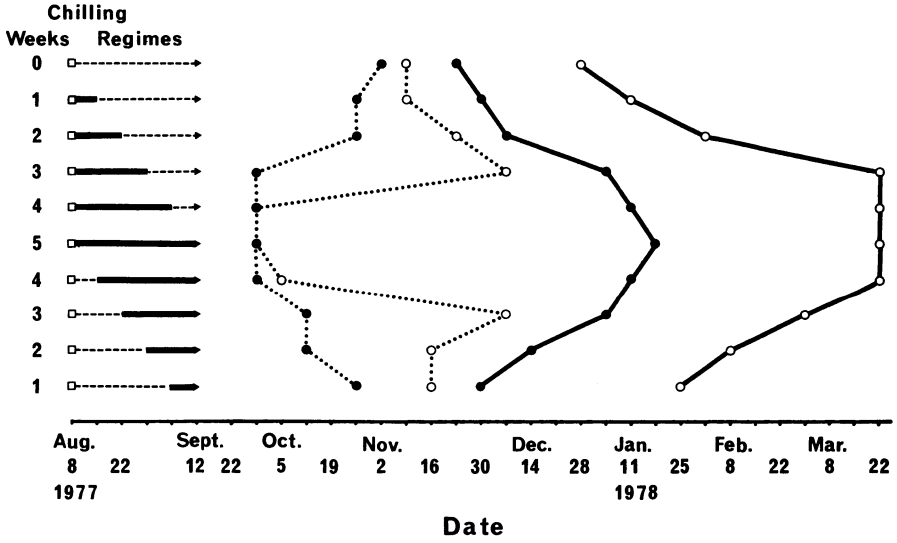

Fig. 2. Effect of the bulb cold treatment prior to planting or scaling on the leaf emergence from the remaining bulb or the newly developed scale bulblet. □ Hot water treatment; ▶ Planting or scaling; ---- 25°C; ____ 10°C; ..... Remaining bulb; _____ Scale bulblet; ● Date of the first leaf emergence; ○ Date of the leaf emergence over 80%.

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Four or 5 weeks of cold treatment significantly promoted shoot emergence off the basal plate (Fig. 2). Emergence began within 17 days after planting and 80% of the shoots had emerged within 24 days. One or 2 weeks of cold treatment did not significantly promote or retard shoot emergence. Three weeks of 10°C gave the greatest difference between the date of first shoot emergence and the date when 80% of the shoots had emerged (Fig. 2).

On the other hand, leaf emergence from the scale bulblet was retarded as cold treatment duration increased. This was true for both the beginning and for the 80% leaf emergence date. This retardation of leaf emergence was most pronounced when bulbs were cold treated for more than 3 weeks.

It is well known that cold treatments promote shoot emergence from Easter lily bulbs, and this has long been employed for programming the bulbs by flower forcers. This was the case in the present experiment: 4 to 5 weeks at 10°C promoted shoot emergence. On the other hand, cold treatments retarded leaf emergence from scale bulblets developed from scales detached from the intact bulb after cold treatment. These differences in reponse suggest that scales, once separated from the whole bulb, behave differently from the remaining bulb core as related to leaf and shoot emergence.

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Deep Supercooling of Winter Flower Buds of *Cornus florida* L.[1]

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Additional index words. flowering dogwood

Abstract. **Differential thermal analysis on winter flower buds of *Cornus florida* revealed that numerous small low temperature exotherms occurred between -15 and -23°C. These exotherms resulted in the death of the winter bud florets. Only a single exotherm near -20°C was observed in individual florets. These observations indicate that the florets of the winter flower bud survive subfreezing by supercooling and that the temperature of the exotherms may be correlated with the minimum temperature occurring at the northern range of the species.**

American flowering dogwood, a deciduous shrub or tree 3 to 6 m in height, is one of the most popular ornamental trees in Europe and America. In the winter flower bud, 4 conspicuous petal-like, notched involucral bracts enclose a dome shaped cluster of tiny greenish flowers about 10 mm in diameter (Fig. 1). The inflorescense consists of 20 to 30 tiny sessile flowers clustered on a common receptacle. The size of each individual flower (floret) is about 1 mm in diameter near the apex and 6 to 7 mm long.

Although most plant tissues survive subfreezing temperatures by tolerating extracellular ice formation, recent work has shown that reproductive tissues of some species survive by avoiding freezing or supercooling. Graham (5) and Graham and Mullin (6) observed low temperature freezing events or exotherms near −30°C in dormant azalea flower primordia in midwinter. Similar freezing avoidance has been observed in flower primordia of several *Prunus* species (8). George et al. (3, 4) employed differential thermal analysis (DTA), nuclear magnetic resonance spectroscopy and cryomicroscopy to show that low temperature exotherms in floral primordia of azalea result from the freezing of supercooled tissue water. These data suggest that supercooling may be a more important freezing resistance mechanism in the flower buds than originally presumed. Supercooling has also been found to be important for the winter survival of living xylem in many hardwoods (1, 2).

This study was designed to determine whether the flower buds of *C. florida* survive subfreezing by supercooling during winter.

Flower buds of *C. florida* were collected in midwinter in Tokyo. The occurrence of exotherms in excised flower buds was investigated by differential thermal analysis (DTA). A copper-constantan thermocouple was inserted near the florets through involucral bracts. Another thermocouple, connected in series with the first, was inserted into another flower bud which had been previously dried in an oven. Flower buds with the inserted thermocouple were placed in a thermos flask

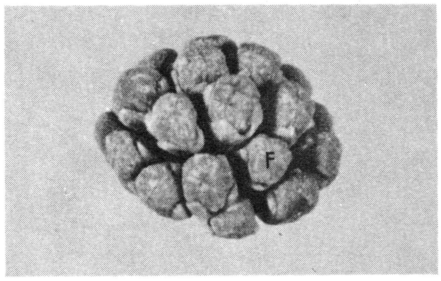

Fig. 1. A dome shaped cluster of florets from a winter flower bud of *Cornus florida* (8 x) with involucral bracts removed (F = Floret).

measuring 7.3 cm in diameter and 20 cm in height and held at 10°C. The flask was immediately transferred to a freezer held at about -42°C. The bud temperature was determined by an additional thermocouple and recorded. Winter buds were cooled at the rate of 0.3°C/min in the temperature range between 0 and -10°C, and 0.1°C/min between -10 and -30°C.

After thawing, flower buds were individually placed in polyenthylene sacks and kept at 20°C for 3 days to evaluate viablility. Browning was used as a criterion for rating injury.

Three types of exotherms were observed by DTA. A large first exotherm (Fig. 2-exotherm A) at about -6°C resulted from the freezing of involucral bracts. In flower buds with bracts removed, exotherm A did not appear on the DTA profile. Second numerous small exotherms (Fig. 2-exotherm B) following exotherm A were probably due to freezing of the receptacle on which the florets are attached. A number of small but more distinct spike-like exotherms totaling about 25 occurred between -13 and -23°C. The number of exotherms generally corresponded to the number of florets on the receptacle of the flower bud. An excised floret was found to produce only one exotherm near -20°C (Fig. 3) which resulted in the death of the floret. A

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