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YEAR-ROUND PRODUCTION OF *PLATYCODON GRANDIFLORUM* A. DC.

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Unsprouted non-dormant stock plants of *Platycodon grandiflorum* were wrapped with polyethylene film and then stored at 5° and 0℃ for 5, 10, 20 and 30 weeks starting on March 16, 1982. After storage, they were planted in 21 cm clay pots and grown in the greenhouse at 15℃ or higher temperarures. The results were as follows:

1. Buds on stock plants elongatd gradually through the storage at 5℃ but did not at 0℃.

2. Buds on the stocks in all treatments grew rapidly after planting to form normal shoots. The shoots except those of some stocks stored for 30 weeks came into flower.

3. Avarage date of flowering of the plants stored for 5, 10, 20 and 30 weeks was late June, mid-late July, late-September to early October and early-January, respectively.

4. It would take about 80 to 90 days for the plants to begin flowering if it was planted in spring or late fall, but in summer it took only about 60 days. Plants stored at 5℃ for 10 weeks or longer flowered earlier than those stored at 0℃.

5. The stem length and number of leaves of flowering shoots varied with individual plants from 60 to 70 cm, 30 to 35 leaves, respectively. The results were not affected with the treatments.

6. Flowers harvested in summer were smaller than those in spring or autumn. Averge number of flowers per shoot varied from 4 to 10 independent on the treatments.

Key words: *Platycodon grandiflorum*, forcing, cold storage.

Introduction

Platycodon grandiflorum (baloon flower) is an important perennial florist plant in Japan. It is grown for a cut flower, a pot flower or a garden flower. Under natural conditions the plant normally initiate flower bud in early May and blooms in June[1,2]. To make it a more valuable flowering plant for market, it is necessary to find ways of forcing it to flower in other seasons of the year.

Kosugi and Marui[2] reported that temperatures higher than 12°～13℃ was necessary for flower bud formation and development of the plant. Photoperiod did not affect flowering. Inoue and Konishi[3] dug out new stocks of the plant and stored them at 0° or 5℃ for four to six weeks in antumn. This treatment caused their dormant buds to develop into shoots after planting and the shoots to flower in spring. Similar result was obtained by Sano and Kosugi[4] when the stock plants were treated with low temperature (2°±2℃) for two to four weeks and

gibberellin. They succeeded in making the plant to flower in late December.

There are some suggestions by growers and reseachers that it might be possible to shift the natural flowering season of the plant to October or November. This should be done by retarding the growth of non-dormant stocks through storage at low temperatures.

This experiment was initiated to evaluate the effects of cold storage of non-dormant stocks on the growth and flowering of *Platycodon grandiflorum* after planting.

Materials and Methods

Two-year old stocks of *Platycodon grandiflorum* cv. 'Samidare' were obtained from a nursery in autumn, 1981. On March 14, 1982, 110 stocks, each having large well developed buds on the crown, were selected and used for experiment.

They were washed with tap water, dipped into 0.1% Benlate solution (fungicide) for one hour and then left to dry on paper under labolatory conditions for 24 hours.

They were divided into eleven groups of ten each. Eight groups directly wrapped with 0.03 mm polyethylene film and stored at 5° and 0℃ for 5, 10, 20 and 30 weeks starting on March 16, 1982. The other three groups were wrapped with wet sphagnum moss and polyethylene film and similary stored at 0℃ for 10, 20 and 30 weeks.

After storage, five stocks were planted in each 21 cm clay pot and grown in the greenhouse at 15℃ or higher.

Results and Discussion

Buds on the stocks storing at 5℃ for over 30 weeks, the longest storage period in the experiment, elongated gradually and developed to about 2 cm in length. They were succulent and pale yellow in color, and damaged easily by handling after the storage. Those on the stocks stored at 0℃ did not elongate during the storage. It is sure that 5℃ was too high to prevent enough the growth of non-dormant buds of stocks. 5℃ was shown, therefore, to be undesirable for storing non-dormant stocks for long period.

Buds on the stocks in all treatments elongated soon after planting to form normal shoots. Most of young shoots were removed and only two shoots on each stock were allowed to grow.

The planting date of the treated stocks and their average date of the first flowering are shown in Table 1. Plants grown during summer (temperature ranged from about 20° to 38℃) flowered more rapidly than those planted in spring (about 10° to 25℃) and late fall (15° to 25℃) (Fig. 1). This result accords with Kosugi et al[2]. Four to six weeks of low temperature have been found necessary to release buds of the plant from dormancy in autumn[3]. In this experiment, long-term storage of non-dormant stocks at 0℃ was shown to be useful in commercial production.

Plants stored at 5℃ for 10 weeks or longer consistently showed earlier flowering than those stored at 0℃ for the same period (Fig. 1); by about 8 to 10 days compared to those stored at 0℃. The clear reason for the earlier flowering is not known, but should be due to the earlier sprouting of buds during the storage at 5℃.

Shoots on some stocks stored for 30 weeks at 0℃ and 5℃ did not flower (Table 1), and

Table 1 Flowering of *Platycodon grandiflorum* grown after cold storage of stock plants before sprouting in spring

Storage		Planting date		% of flowering shoot	Av. date of flowering		Av. number of flowers per shoot
Duration (wks.)	Temperature (℃)						
0	—	March	16	100	June	16	6.4
5	5	April	20	100	June	26	5.6
5	0	April	20	100	June	26	5.6
10	5	May	25	100	July	14	7.3
10	0	May	25	100	July	24	8.1
10	0*	May	25	100	July	24	10.1
20	5	August	3	100	September	22	8.1
20	0	August	3	100	October	1	4.0
20	0*	August	3	100	October	1	5.0
30	5	October	12	88	October	28	5.4
30	0	October	12	100	January	5	5.3
30	0*	October	12	90	January	5	3.6

* Stock plants were stored in sphagnum moss wrapped with polyethylene film

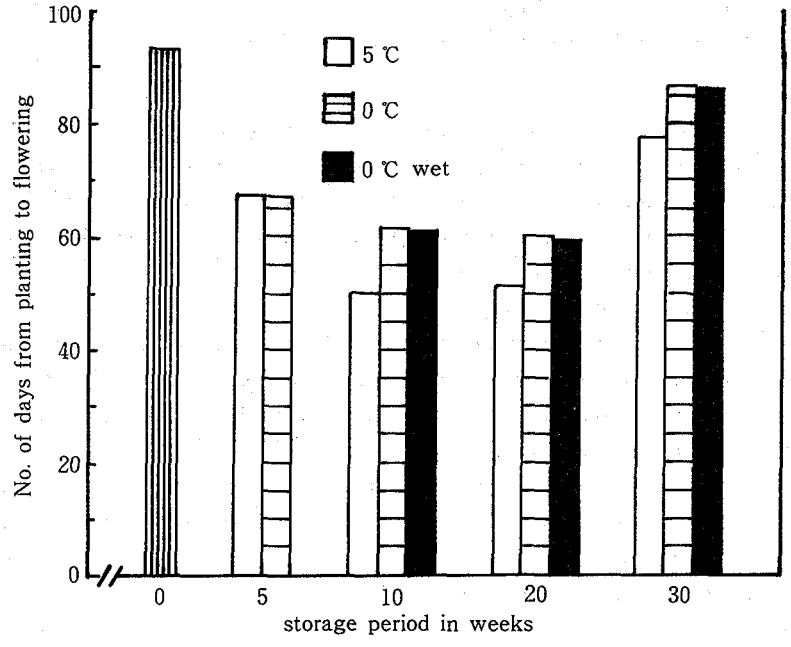

Fig 1 The effect of cold storage of non-dormant stock plants on the flowering of *Platycodon grandiflorum* A. DC.

they appeared thin and weak. On some, leaves showed some extend of fungicidal injury. Long-term storage might cause non-dormant stocks to consume food reserves and this, in turn might result less vogour of them. From the practical point of view, a cold storage longer than 30 weeks is not advisable for the stock plants of *Platycodon grandiflorum*.

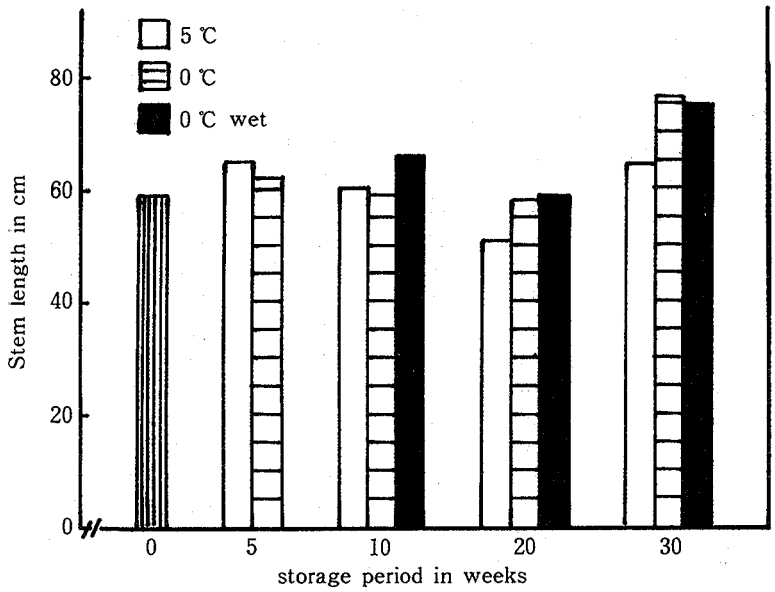

Fig 2 The effect of cold storage of non-dormant stock plants on the stem length of flowering shoots of *Platycodon grandiflorum* A. DC.

In Japan, the stock plants of *Gypsophilla paniculata* tend to rot suffering from high temperature in summer. To avoid the trouble they are stored at low temperature for long period from summer to autumn. For good results, however, the storage is limited to only three to four months. Tree species such as hydrangea[5], tree paeony[6] and wisteria[7], which came into flower commonly in spring, are also stored at low temperature for autumn flowering. In that case, however, the results are not always stable.

The stem length and the number of leaves of flowering shoots varied with individual plant from 60 to 70 cm and 30 to 35 leaves respectively (Fig. 2 and 3). These results showed that the cold storage of non-dormant stocks with or without moisture did not give any qualitative effects on the subsequent growth and development of the plant.

Flowers produced in summer were smaller and more feeble than those in other seasons. The plants grew and flowered faster in hot summer than in cooler seasons (Fig. 1). In the case, nutritional competition was thought to be serious among flower buds at higher temperatures compared to cooler temperatures.

Average number of flowers per shoot varied from about four to ten independent of the treatments (Table 1).

From all the results it could be concluded that *Platycodon grandiflorum* is amendable to forcing to enable flowering anytime during June to January by means of storing non-dormant stocks at 0℃.

Procedures recomended for practical purposes are; (1): Unsprouted non-dormant stocks treated with fungicide need to be wrapped with polyethylene film in late January. They should be stored at 0℃ within 30 weeks. (2): They need to be planted as soon as possible after

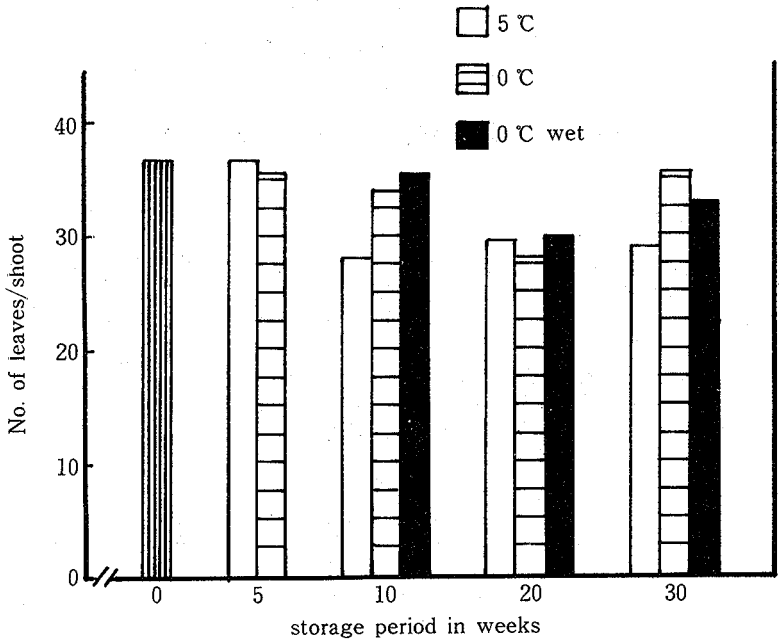

Fig. 3 The effect of cold storage of non-dormant stock plants on the number of leaves of flowering shoots of *Platycodon grandiflorum* A. DC

storage. (3): They should be grown for 50～60 days before harvest in summer and 80 to 90 days in spring and autumn.

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株貯蔵によるキキョウの周年生産

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キキョウを夏から冬にかけて開花させる方法を見出すため，春に発芽前の株を殺菌後に0℃および5℃で冷蔵し，30週間後まで一定期間ごとに取り出して栽培した。

1) 貯蔵にあたっては，水分の補給は不要で，株をポリエチレンで包むだけでよかった。

2) 5℃では長期冷蔵中に芽が伸長した。この芽は傷みやすいが，定植後，急速に伸長し開花した。0℃では，株は入庫後ずっと同じ状態に保たれ，それらの株は定植後も正常に成育した。しかし，30週間後に定植した株では貯蔵温度にかかわらず一部の芽が開花しなかった。

3) 貯蔵方法によりやや異なるが，開花時期は貯蔵期間5，10，20，30週間に対し，それぞれ，6月下旬，7月中・下旬，9月下旬～10月上旬および1月上旬であった。これを到花日数でみると，貯蔵期間とは無関係に，春と秋の定植で80～90日，夏には約60日であった。また，5℃貯蔵株は0℃よりやや早く開花した。

4) 開花したシュートの茎長と葉数は，処理に無関係に，60～70cmおよび30～35枚であった。

5) 夏に収穫した花は春や秋の花より小輪であった。また，1本あたりの花数は処理に無関係に4～10であった。