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Cultivar Selection of Tree Peony Suitable for December Flowering

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12月促成開花に適したボタンの品種選抜

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Cultivars of tree peony (*Paeonia suffruticosa* Andr.) suitable for December flowering were searched. Two-year old grafted plants were lifted from the field, chilled at 3 °C for 47 days from late September, planted in the pots and cultured in the heated glasshouse. Pink cultivars, 'Hanakisoi' and 'Yatsukajishi' successfully flowered in late December. 'Yatsukajishi' needed prechilling treatment (15 °C for 11 days) for normal leaf extension. Red cultivars, 'Higurashi' and 'Nichigetsu-nishiki' also successfully flowered although days from planting to flowering in 'Higurashi' were relatively long. Purple cultivars, 'Shimadaijin' and 'Hanadaijin' were also suitable cultivars for December flowering. White cultivars were very difficult since flower blasting occurred at high rate. It was demonstrated in the test of 'Hanakisoi' that the bud size before chilling was closely related with occurrence of blasting. Thus, plants with large buds (10 mm or so in diameter) should be used for commercially successful flowering (80 % or above) in December.

Introduction

Tree peony has been produced long as one of the garden ornamental trees. The demand for nursery plants is, however, not increasing due to limited space of gardens in recent urban houses. Meantime, consumers are rather expecting production of cut and pot plants for use of indoor ornamentals, especially in winter and spring seasons. Forced flowering for March and April is simply realized by lifting plants and growing them in the heated or unheated plastic house. On the contrary, December flowering aimed for New Years Holiday needs special technique to overcome some problems such as delay of sprouting due to bud dormancy and occurrence of flower bud abortion. The authors have already shown, using a standard cultivar, 'Hanakisoi' that December flowering could be realized by treating the whole plants with chilling 50 days from late September (Hosoki *et al*, 1983, 1984).[1)2)] Here, prechilling

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treatment accelerated sprouting and flowering date as well as it promoted leaf extension. But, problems of flower bud abortion still remained unresolved, which is probably induced by chilling plants with small buds, by giving prechilling treatment or/and by improper cultivar selection. Meantime, the consumers are expecting various types of flowers with different color and shape.

Here, we serched cultivars suitable for December flowering from those with different color and shape. Also, we checked a correlation between bud size at chilling time and rate of flower blasting after planting, using a standard cultivar 'Hanakisoi'.

Materials and Methods

Correlation between bud size and success rate of forced flowering

Three or four-year old grafted plants of 'Hanakisoi', which had different bud size (7–10 mm in diameter) (late sepal or early petal formation stage) (Hosoki *et al.*, 1986),[3] were dug on Sept. 25, 1985 from Shimane Univ. field. The terminal bud size of 20 plants was recorded indiviaually and after removal of all the leaves (already yellowed), root portion was wrapped with moist sphagnum moss to avoid dryness. Then, the whole plants were covered with a plastic film and chilled at 3 °C for

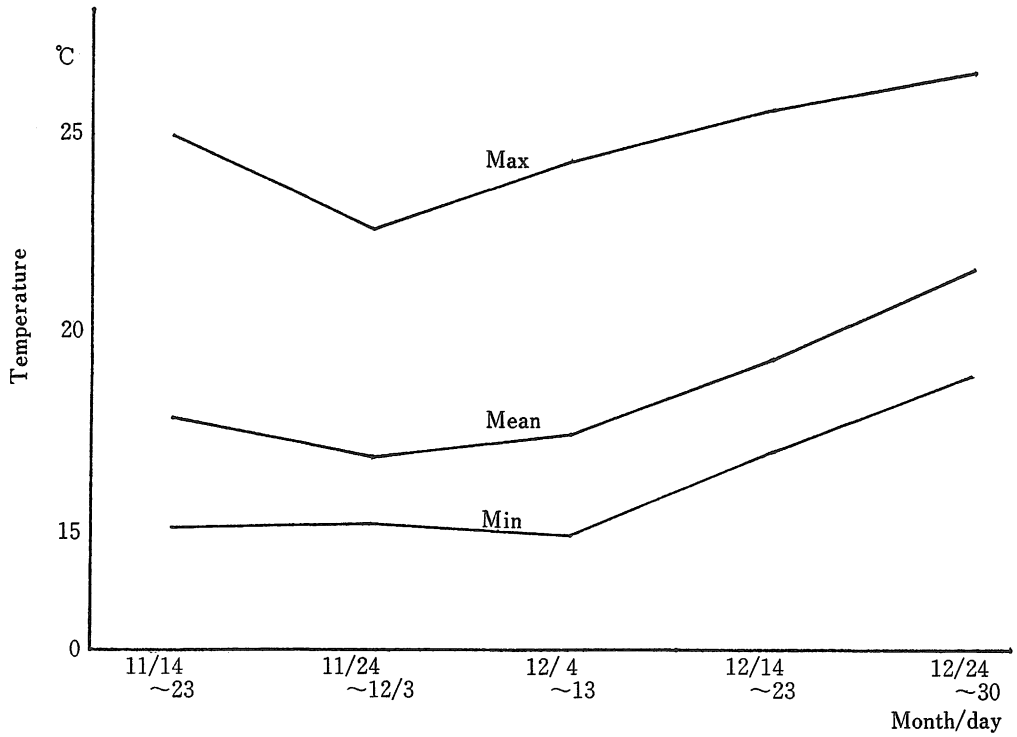

Fig. 1 Mean, maximum and minimum temperature from planting to flowering in the heated glasshouse (1985) (average values of 10 day intervals).

Table 1. Correlation between bud size and rate of normal flowering ('Hanakisoi')

Bud size in diameter (mm) before chilling	Flower bud abortive at sprouting	Flower bud blasting during culture	Normal flowering
7	* * * * [z]	*	
8–9	*	* *	* * * * * * * * *
10 or above			* * *

[z] Each star mark (*) indicates individual plant. Total 20 plants were divided into 3 groups based on bud size before chilling.

Table 2. Flower quality and leaf extension at flowering

Bud size in diameter (mm) before chilling	Sprouting date (month/day)	Sprouting rate (%)	Harvest date (month/day)	Harvestable flower rate (%)	Cumulative temp. (planting to harvest) (degree·day)
7	11/28[a] [y]	100	— [x]	0	—
8–9	11/28[a]	100	12/26[a]	75	766
10 or above	11/28[a]	100	12/26[a]	100	769

[z] Foliage width (see Fig. 2)

[y] Values followed by the same letter one not significantly different ($P = 0.05$) among plants with different bud size.

[x] No flowering at all.

Table 3. Cultivar difference of tree

Cultivar	Prechilling	Sprouting date (month/day)	Sprouting rate (%)	Harvest date (month/day)	Harvestable flower rate (%)	Cumulative temp. (planting to harvest) (degree. day)
Hanakisoi	−	12/1 [y]	100	12/27[a]	100	788
	+	11/27[a]	100	12/26[a]	60	765
Yatsukajishi	−	11/26[a]	100	12/24[a]	80	718
	+	11/25[a]	100	12/23[a]	83	697
Shinshichi-fukujin	−	12/4[a]	83	12/31[a]	50	882
	+	12/6[a]	60	12/29[a]	40	834
Higurashi	−	12/1[a]	100	12/30[a]	83	857
	+	11/29[a]	100	12/29[a]	33	834
Kaoh	−	12/2[a]	100	— [x]	0	—
	+	12/1[a]	83	12/26	17	765
Shimadaijin	−	12/1[a]	67	12/24[a]	33	718
	+	11/30[a]	83	12/24[a]	67	718
Imamurasaki	−	11/26[a]	100	—	0	—
	+	11/25[a]	100	12/19	33	614
Godaishu	−	11/29[a]	100	12/29[a]	20	834
	+	12/1[a]	100	12/27[a]	20	788
Tamasudare	−	12/7[a]	60	1/3	20	953
	+	12/6[a]	60	—	0	—

[z] Foliage width (see Fig.2)

[y] Values followed by the same letter one not significantly different ($P = 0.05$) between two treatments with and without prechilling.

[x] No flowering at all.

47 days from Sept. 26 to Nov. 12. After chilling, they were planted in the plastic pots (ϕ 24 cm) containing sandy soil medium mixed with 40 % manure and then cultured in a heated glasshouse. The average values of daily minimum, maximum and mean temperature at 10 day intervals are shown in Fig. 1. The sprouting date, the harvest date at flowering (petals just emerging from the calyx), length of flower stem, flower diameter, petal number, fresh weight of total petals and leaves and degree of leaf extension (maximum width of foliage) as shown in Fig. 2 were recorded.

Cultivar difference of forced flowering in December

in forcing of plants with different bud size

Stem length (cm)	Flower diameter (cm)	Petal number	Total petal weight (fw., g)	Leaf extension[z] (cm)	Total leaf weight (fw., g)
—	—	—	—	—	—
30.8[a]	15.7[a]	48.4[a]	9.8[a]	37.4[a]	13.2[a]
30.7[a]	15.3[a]	51.7[a]	11.4[a]	43.3[a]	16.2[a]

peony in December flowering

Stem length (cm)	Flower diameter (cm)	Petal number	Total petal weight (fw., g)	Leaf extension[z] (cm)	Total leaf weight (fw., g)
31.3[a]	14.0[a]	48[a]	8.1[a]	31.3[a]	12.7[a]
30.9[a]	15.2[a]	44[a]	8.7[a]	30.3[a]	10.4[a]
25.9[a]	15.5[a]	70[a]	16.8[a]	8.1[b]	1.6[a]
26.7[a]	13.7[a]	53[a]	11.1[a]	21.8[a]	6.0[a]
26.9[a]	14.5[a]	67[a]	10.7[a]	20.5[a]	3.8[a]
32.2[a]	12.9[a]	53[a]	9.4[a]	18.3[a]	2.5[a]
29.1[a]	13.7[a]	24[a]	7.4[a]	38.6[a]	14.3[a]
29.5[a]	15.2[a]	22[a]	7.6[a]	41.7[a]	18.1[a]
—	—	—	—	—	—
29.7	14.7	79	11.5	34.6	13.4
23.6[a]	14.1[a]	49[a]	11.3[a]	34.2[a]	18.9[a]
19.2[a]	13.2[a]	48[a]	9.9[a]	27.9[a]	10.8[a]
—	—	—	—	—	—
19.1	8.5	13	2.1	31.3	5.7
23.2[a]	13.0[a]	52[a]	8.3[a]	17.6[a]	1.5[a]
21.5[a]	12.5[a]	54[a]	7.3[a]	17.9[a]	2.2[a]
23.2	6.5	33	2.4	28.6	6.6
—	—	—	—	—	—

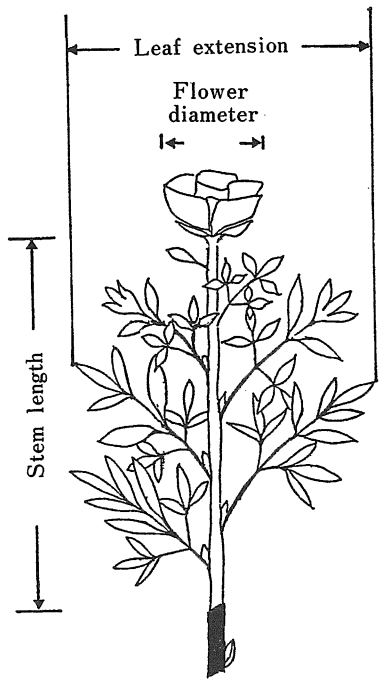

Fig. 2 Criteria for measurements of leaf extension, stem length and flower diameter at flowering time. Length of old stem (black bar) is not included.

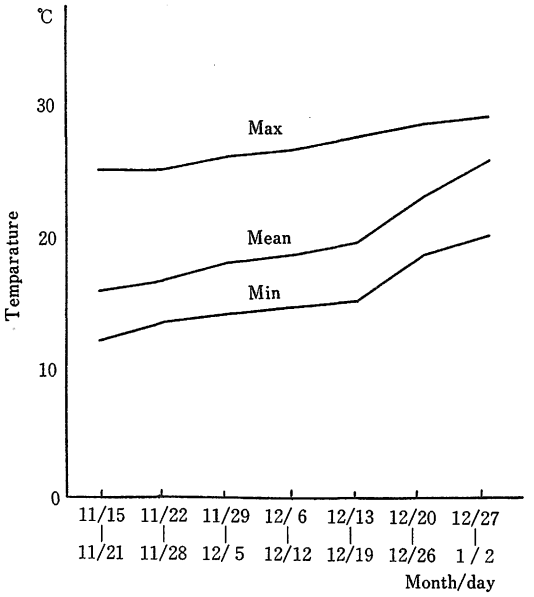

Fig. 3 Mean, maximum and minimum te mperature from planting to flowering in the heated glasshouse (1987) (average values of 7 day intervals).

Two-year old grafted plants of 9 cultivars 'Hanakisoi', 'Yachiyotsubaki' and 'Shin-shichifukujin' (pink fl.), 'Higurashi' and 'Kaoh' (red fl), 'Shimadaijin' and 'Imamurasaki' (purple fl.) and 'Godaishu' and 'Tamasudare' (white fl.) were dug on Sept. 17, 1987 from the field. The plants having only large flower buds (about 10 mm in diameter) were selected. Half of the plants were prechilled at 15 °C for 11 days and then chilled for 47 days from Sept. 28 to Nov. 15. The other half were replanted in the field under 90 % shading with a black netted plastic cover to avoid dryness, kept for 11 days (mean temperature at 20 °C) and then directly chilled at 3 °C from Sept. 28. Six plants were replicated for each treatment. After chilling, all the plants were potted and cultured in the glasshouse as in the former experiment. The same survey was conducted. The temperature regime in the glasshouse is shown in Fig. 3.

For additional cultivar selection, 'Nichigetsunishiki' (red fl.) 'Hanadaijin' (purple fl.) were tested. Two-year old grafted plants were chilled without pretreatment from Sept. 25 and Sept, 24, respectively. Both cultivars were planted on Nov. 12 in the heated glasshouse and the similar temperature management was conducted.

Results

Correlation between bud size and success rate of forced flowering

The plants, which had small buds (7 mm in diameter) at the start of chilling, did not make appearance of flower bud at sprouting, except one plant in which the flower bud appeared but resulted in blasting during culture (Table 1). The plants which had buds of 8–9 mm in diameter, made appearance of flower bud and resulted in 75 % flowering, the rest 2 plants getting blasting during culture and one plant being abortive at sprouting. The plants which had large buds (10 mm in diameter), reached 100 % flowering. Date of sprouting and harvest, cumulative temperatures from planting to harvest, stem length, flower diameter, and fresh weight of petals did not differ among plants with different bud size, although leaf extension and leaf weight were slightly greater in the plants with large flower buds (Table 2).

Cultivar difference of forced flowering in December

For pink cultivars, 'Hanakisoi' sprouted in Dec. 1 and flowered normally in Dec.27 (Table 3). Flowering rate was 100 %. Flower quality (flower diameter, petal numbers, fresh weight of total petals) and leaf extension were marketable enough for December shipping. Prechilling treatment slightly accelerated date of sprouting and flowering, but it induced blasting as often observed in practical culture. 'Yatsukajishi' sprouted and flowered relatively early among the tested cultivars. The cumulative temperature was one of the smallest in all the cultivars. Flowering rate in plants without prechilling treatment was 80 % ; only one plant became blasting. The fresh weight

Fig. 4 Flowering of 'Yatsukajishi' treated with prechilling (left) and without (right). Prechilling treatment promoted leaf extension without inducing blasting in this cultivar.

Table 4. December flowering in

Cultivar	Sprouting date (month/day)	Sprouting rate (%)	Harvest date (month/day)	Harvestable flower rate (%)	Cumulative temp (planting to harvest) (degree. day)
Nichigetsunishiki	11/26	100	12/20	100	805
Hanadaijin	11/24	100	12/23	83	739

[1] Foliage width (see Fig. 2)

of total petals was the largest, giving an appearance of gorgeous flower shape. However, leaf extension was very poor resulting in imbalance to flower size (Fig. 4). Prechilling treatment greatly promoted leaf extension without increasing blasting rate, and recovered a normal balance between leaf and flower size. 'Shin-shichifukujin' sprouted and flowered very late. Flowering rate was not so high, 40-50 % regardless of prechilling treatment. For red cultivars, flowering rate of 'Higurashi' was 83 %. Flower quality and leaf extension were marketable enough, although days from sprouting to flowering was relatively long. Another cultivar 'Kaoh' sprouted normally, but all except one became blasting regardless of prechilling treatment. For purple cultivars, flowering rate in 'Shimadaijin' was 67 % in prechilling treatment while it was 33 % without prechilling treatment. The flower quality and leaf extension were marketable enough in either treatment. In 'Imamurasaki', the sprouting was the earliest but most of buds turned out to be vegetative regardless of prechilling treatment. For white cultivars, flowering rate of 'Godaishu' was also low due to blasting although the flower buds developed up to about 2 cm in diameter and the flower stem elongated up to 15-20 cm. Sprouting of 'Tamasudare' was very late and most of the flower buds became blasting during culture.

For additional cultivar selection, 'Nichigetsunishiki' and 'Hanadaijin' flowered normally at 100 % and 83 %, respectively (Table 4). The cumulative temperature of 'Nichigetsunishiki' was intermediate while that of 'Hanadaijin' was one of the smallest. Flower quality and leaf extension of 'Hanadaijin' were marketable enough while petal number and leaf extension of 'Nichigetsunishiki' still needed improvement.

Discussion

Commercial production of tree peony for December flowering was recently established by the nurserymen, using two-year old grafted plants of a standard cultivar 'Hanakisoi', since the starting date of chilling treatment and the duration was clarified (Hosoki *et al.*, 1984).[2)] However, there are still problems to be resolved. First, increasing flowering rate up to 70-80 % for commercially minimum paying; second, maintaining proper balance of flower and leaf size; Third, application of 'Hanakisoi' 's method to the other cultivars with different color and shape.

In the first experiment, a correlation between bud size and flowering rate was investigated using 'Hanakisoi'. The plants with small buds did not show normal

'Nichigetsunishiki' and 'Hanadaijin'

Stem length (cm)	Flower diameter (cm)	Petal number	Total petal weight (fw.,g)	Leaf extansion[1] (cm)	Total leaf weight (fw., g)
13.8	12.0	25	5.0	19.1	7.9
28.3	12.1	47	11.1	41.2	14.1

flowering; most of these flower buds became abortive at the very beginning of sprouting. This would be due to weak sink in the small bud since plant size including storage roots did not differ so much regardless of bud size. Thus, plants with large buds (approximately, 10 mm in diameter), should be used for successful flowering in December.

prechilling treatment is not suitable for 'Hanakisoi' since it induced blasting. On the contrary, prechilling treatment is necessary for 'Yatsukajishi' since it promoted leaf extension resulting in normal balance between leaf and flower. Prechilling treatment did not induce blasting in this cultiver. 'Yatsukajishi' seems to have strong sink in the flower bud as conceivable from a great number of petals and heavy flowers. Prechilling treatment would slightly suppress growth activity of the terminal flower bud and shift it to leaf growth. Another pink cultivar, 'Shinshichifukujin' was not so suitable for forcing since flowering rate was 40–50 % regardless of prechilling treatment. For red cultivar, 'Higurashi' reached 83 % flowering, and flower quality and leaf extension were also marketable enough. Prechilling treatment was not applicable since it increased blasting rate as in 'Hanakisoi'. Another red cultivar, 'Kaoh' was unsuitable for December flowering since almost all the plants became blasting in both treatments. This fact implies that an another factor besides bud size is responsible for occurrence of blasting depending on cultivars. For purple cultivar, 'Shimadaijin' showed 67 % flowering in plants with prechilling treatment. Lower flowering rate in plants without prechilling remained unresolved. Another purple cultivar 'Imamurasaki' has no potential for forced flowering in December since most of them were still vegetative in late September. For white cultivars, flowering rate was low, suggesting that an alternative cultivar such as 'Renkaku' should be used (data not shown).

For the other two cultivars, 'Hanadaijin' (purple) was highly marketable and 'Nichigetsunishiki' (red) would become a suitable cultivar since leaf extension was improved by prechilling treatment although flowering rate reduced to 75 % (data not shown).

In conclusion, 'Hanakisoi' (pink), 'Yatsukajishi' (pink), 'Higurashi' (red) and Hanadaijin' (purple) are suitable cultivars for December flowering. 'Shimadaijin' (purple) and 'Nichigetsunishiki' (red) are also potential cultivars since flowering rate was 67 % and 100 %, respectively.

References

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摘　　要

12月促成開花に適したボタン品種の選抜が行われた．接ぎ木2年生株を9月下旬から3℃で47日間冷蔵し，加温ガラス室内で促成した．桃系品種では‘花競’と‘八束獅子’が12月下旬に開花した．‘八束獅子’では予備冷蔵（15℃，11日間）を行うことで葉の伸展がよくなった．赤系品種では‘日暮’と‘日月錦’が開花したが，前者では日数を要し12月末の開花となった．紫系品種では‘島大臣’と‘花大臣’が12月下旬に開花した．白系品種ではブラインドが多く有望な品種はなかった．‘花競’を用いて，冷蔵前の花芽の大きさとブラインド発生の関係を調べると，花芽直径が 8mm 以下の場合不開花が多く 10mm 近くの場合では高い開花率（80%以上）となった．