Effects of BA Treatment on Growth and Flowering of Some Vegetative Lines of *Gypsophila paniculata* L. 'Bristol Fairy'

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Summary

Application of 300 ppm BA (6-benzylaminopurine) promoted flower initiation and advanced blooming by about half a month in a heated plastic house under long-day conditions in BF-04, BF-08 and BF-13 vegetative lines of *Gypsophila paniculata* L. 'Bristol Fairy', but not in BF-20 line. BA treatment also promoted flowering in BF-08 and BF-13 lines even when grown in an unheated plastic house under natural daylength. BA treatment seemed to substitute for chilling for the induction of flowering, and consequently plants treated with BA overcame unfavorable growing conditions.

On the other hand, GA₃ (gibberellic acid) did not promote flower initiation in any lines grown in an unheated plastic house under natural daylength.

Thus, cut flower production of gypsophila from autumn to winter is possible even in an unheated plastic house under natural daylength by the selection of vegetative lines with low chilling requirement such as BF-08 or BF-13, and the application of BA.

Introduction

Gypsophila cut flowers have been produced throughout the year in Japan by various cropping methods. 'Bristol Fairy' is the leading cultivar in this case. This plant forms rosettes under natural conditions from autumn to winter(8). Once rosettes are formed, they require exposure to a certain amount of chilling to be released from rosettes (physiological dormancy) and ultimately to flower(9).

'Bristol Fairy' often shows non-uniform growth in spite of being vegetatively propagated, and failure to bloom is observed in some cases. Differences in critical photoperiods (3) and/or chilling requirements(1) among vegetative lines of 'Bristol Fairy' appear to be responsible for the non-uniform growth. And it has been noticed that long-day treatment(5) and cold storage of stocks(9) were effective for

avoiding rosette-like and non-uniform growth.

On the other hand, it was found that repeated treatments with GA₃ or GA₄₊₇ did not promote flowering in short days but did so in long days at low night temperature(7). In our preliminary experiments, BA treatment was more effective than GA₃ in breaking the rosettes of gypsophila plants that had been exposed to insufficient chilling(9).

The present report concerns the effects of BA treatment on the growth and flowering of some vegetative lines with different chilling requirements, which were selected from 'Bristol Fairy'.

Materials and Methods

Experiments were carried out on selected vegetative lines with different chilling requirements which had been proved in our previous report(1).

The selected vegetative lines, BF-04, BF-08, BF-13 and BF-20, were used. Each line was propagated by terminal cutting on July 1, and rooted cuttings were transplanted to 7.5 cm pots on August 1 and pinched on August 15. Finally each plant with two lateral shoots was planted in a 18 cm plastic pot and grown in

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Table 1. Effects of GA₃ and BA treatments on flowering of some vegetative lines of 'Bristol Fairy' grown in a heated plastic house under long-day conditions.

Line number	Start of heating	Chemical treatment ^z	Flower bud emergence (%)	Blooming (%)	Blooming date	(Days to bloom ^y)
04	Sep. 30	—	19	19	—	(—)
04	Sep. 30	GA ₃	38	38	—	(—)
04	Sep. 30	BA	100	100	Dec. 2	(109 a ^x)
04	Oct. 30	—	13	13	—	(—)
08	Sep. 30	—	94	88	Jan. 1	(139 b)
08	Sep. 30	GA ₃	100	100	Dec. 18	(125 c)
08	Sep. 30	BA	100	100	Dec. 3	(110 a)
08	Oct. 30	—	81	75	Jan. 2	(140 b)
13	Sep. 30	—	100	94	Dec. 17	(124cd)
13	Sep. 30	GA ₃	94	88	Dec. 17	(124cde)
13	Sep. 30	BA	100	100	Dec. 4	(111 a)
13	Oct. 30	—	88	69	Dec. 30	(137 b)
13	Oct. 30	GA ₃	94	94	Dec. 27	(134bd)
13	Oct. 30	BA	100	88	Dec. 27	(134be)
20	Sep. 30	—	6	6	—	(—)
20	Sep. 30	GA ₃	6	6	—	(—)
20	Sep. 30	BA	19	19	—	(—)
20	Oct. 30	—	0	0	—	(—)
20	Oct. 30	GA ₃	0	0	—	(—)
20	Oct. 30	BA	31	31	—	(—)

^z Chemicals were applied just before the start of heating.^y Days from Aug. 15.^x Mean separation in a column by Duncan's multiple range test, 5% level.

an unheated plastic house under natural daylength until treated chemically.

Propylene glycol (15%) solution containing 300 ppm BA (6-benzylaminopurine) was applied by spraying the shoots (5 ml/plant) on September 30 or October 30. Iso-propyl alcohol (15%) solution containing 300 ppm GA₃ (gibberellic acid) was also applied in the same way on September 30 for comparison. Half of the plants of each line were grown in a heated plastic house, in which the minimum temperature was maintained not below 15°C and the daylength was extended to 16 h by incandescent lamps. The other half were grown in an unheated plastic house under natural daylength.

Flower stalks were harvested from the basal portion of the stems when about 30% of the florets had bloomed. Cut flower length, cut flower weight and number of nodes to terminal floret and those with lateral inflorescences on the main stem of cut flowers were measured. Cut flower shape was divided into three types as shown in Table 3.

The experiment was terminated on January 31.

Results

Table 1 shows the results with plants grown in a heated plastic house after chemical treatment. When heating and long-day treatment were started on September 30, BF-04 and BF-20 lines hardly bloomed without chemical treatments. In BF-08 and BF-13 lines about 90% of the shoots bloomed.

GA₃ treatment had little effect on the rate of flower bud emergence and blooming, and it advanced the blooming date only in BF-08 line.

BA treatment induced bolting immediately after the start of heating and 100% of the shoots bloomed in BF-04, BF-08 and BF-13 lines. However, it had only a slight effect on the bolting of BF-20. BA treatment also advanced blooming by about half a month when applied on September 30, but this effect was not clear in BF-13 when treated on October 30.

Table 2. Effects of GA₃ and BA treatments on flowering of some vegetative lines of 'Bristol Fairy' grown in an unheated plastic house under natural daylength.

Line number	Date of treatment	Chemical treatment	Flower bud emergence (%)	Blooming (%)	Blooming date	(Days to bloom ^z)
04	—	—	0	0	—	(—)
04	Sep. 30	GA ₃	0	0	—	(—)
04	Sep. 30	BA	100	31	—	(—)
08	—	—	31	0	—	(—)
08	Sep. 30	GA ₃	44	0	—	(—)
08	Sep. 30	BA	100	81	Jan. 23	(161 a ^y)
13	—	—	50	0	—	(—)
13	Sep. 30	GA ₃	50	0	—	(—)
13	Sep. 30	BA	100	88	Jan. 21	(159 a)
13	Oct. 30	GA ₃	75	0	—	(—)
13	Oct. 30	BA	88	0	—	(—)
20	—	—	0	0	—	(—)
20	Sep. 30	GA ₃	0	0	—	(—)
20	Sep. 30	BA	0	0	—	(—)
20	Oct. 30	GA ₃	0	0	—	(—)
20	Oct. 30	BA	6	0	—	(—)

^z Days from Aug. 15.^y Mean separation in a column by Duncan's multiple range test, 5% level.

When plants were grown in an unheated plastic house under natural daylength, rates of flower bud emergence in BF-04, BF-08, BF-13 and BF-20 lines without chemical treatment were 0, 30, 50 and 0%, respectively (Table 2).

GA₃ treatment did not greatly promote flowering of any lines.

BA treatment induced bolting in BF-04, BF-08 and BF-13 lines. When BA was applied on September 30, flower buds became visible in early December and flower bud emergence was 100% in these three lines. In late January, 80 to 90% of shoots treated with BA bloomed in BF-08 and BF-13 lines. Flower buds emerged in 88% of shoots in BF-13 when BA was applied on October 30.

Compared with cut flowers obtained from control plants grown in a heated plastic house under long-day condition, those obtained from BA treated plants were about 30 to 40 cm shorter and their number of nodes decreased (Table 3). Cut flower weight, number of nodes with lateral inflorescences on the main stem of cut flowers and cut flower shape were not affected by BA treatment when plants were grown in a heated plastic house. Cut flowers from the plants treated with BA and grown in an unheated plastic house were

heavier than those from heated ones.

Discussion

Exposure to high temperature during summer is known to induce dormancy of gypsophila plants, and consequently they formed rosettes under natural conditions in autumn(2, 8, 10). Exposure to chilling is necessary for these rosette plants to grow into caulescent plants and to bloom. Different chilling requirements of vegetative lines of 'Bristol Fairy' were discussed in our previous report(1). BF-20 line required the most chilling exposure among four vegetative lines used in this experiment, followed by BF-04. These two lines already became dormant by September 30. BF-08 and BF-13 lines, which required a little chilling, kept their rosette-like growth under low night temperature, short days and low light intensity in autumn. But they had the potential of flowering, because most of their shoots bloomed, when heating and long-day treatment were started on September 30. BA application promoted release from rosette-like growth and consequent flowering in BF-04, BF-08 and BF-13 lines under both of the cultural conditions mentioned above. Thickening of the stems and development of lateral buds were observed after BA treatment (data not shown).

Table 3. Effects of GA₃ and BA treatments on cut flower quality of some vegetative lines of 'Bristol Fairy'.

Line number	Start of heating	Date of treatment	Chemical treatment	Cut flower length (cm)	Number of nodes to terminal floret on main stem	Cut flower weight (g)	Number of nodes with lateral inflorescences on main stem	Cut flower shape ^z		
								A (%)	B (%)	C (%)
Heated and long day ^y										
04	Sep. 30	—	—	78 a ^x	29af	41 a	11 a	3	72	25
08	Sep. 30	—	—	141be	39bd	53 b	15 b	79	21	0
08	Sep. 30	Sep. 30	GA ₃	145 b	36 c	62bc	15 b	87	13	0
08	Sep. 30	Sep. 30	BA	101 c	28af	55 b	14 b	78	16	6
08	Oct. 30	—	—	120 d	39be	52 b	13ab	63	29	8
13	Sep. 30	—	—	131df	36ce	64bc	15bc	87	13	0
13	Sep. 30	Sep. 30	GA ₃	132de	37cd	61bc	16bc	86	14	0
13	Sep. 30	Sep. 30	BA	99 c	30 a	50ab	14 b	69	31	0
13	Oct. 30	—	—	135bef	40 b	58bc	16bc	77	23	0
13	Oct. 30	Oct. 30	GA ₃	139bef	40 b	64bc	15bc	80	20	0
13	Oct. 30	Oct. 30	BA	122 d	38de	59bc	14abc	57	39	4
Unheated and natural daylength										
08	—	Sep. 30	BA	99 c	28 f	74cd	16bc	96	0	4
13	—	Sep. 30	BA	98 c	29af	84 d	17 c	92	4	4

^z Cut flowers were divided into three types as following figures.^y The minimum temperature was maintained not below 15°C and the daylength was extended to 16 h.^x Mean separation within columns by Duncan's multiple range test, 5% level.

The number of nodes on cut flowers decreased after BA application but it was not affected by cultural conditions after BA treatment. This suggests that vegetative growth of the apical meristem ceased and flower bud formation was initiated immediately after BA treatment.

After BA application flower buds and inflorescences developed even in an unheated plastic house under natural daylength. The daylength became about 13 h on September 30 and about 12 h on October 30 including dawn and dusk, and minimum temperature fell below 10°C in late October. It has been reported that gypsophila is a long-day plant(4,6) and its critical photoperiod ranges from 12 h to 18 h(3). However, plants which had been exposed to enough chilling were able to bloom under 10 h daylength(10). That is, the critical daylength of gypsophila should be discussed in the light of its previous chilling exposure. And the ranges of temperature for growth and flowering also depend on that. After exposure to enough chilling, gypsophila plants may be able to bloom at shorter daylengths than has been considered as critical. BA treatment seems to substitute for chilling, so that BA treated plants overcame unfavorable conditions for growth and flowering.

It has been reported that BA treatment made flower stalks shorter and weaker, when the plants were grown in a heated plastic house(9). As our results show, when BA was applied to vegetative lines with low chilling requirement such as BF-08 or BF-13, cut flower production of gypsophila from autumn to winter was possible under the temperature conditions of an unheated plastic house without long-day treatment. In this case, the flower stalks of these lines treated with BA were long and thick enough for cut flowers, and their quality was excellent. However, adequate vegetative growth before BA treatment was necessary for getting cut flowers with good quality.

It is suspected that pinkish-flowered cultivars, 'Flamingo' and 'Red Sea', which require less chilling than any 'Bristol Fairy' vegetative lines, are also profitable for cut flower produc-

tion from autumn to winter.

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シュッコンカスミソウ ‘ブリストル・フェアリー’ 栄養系統の
生長と開花に及ぼす BA 処理の影響

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摘 要

シュッコンカスミソウ *Gypsophila paniculata* L. ‘ブリストル・フェアリー’ 栄養系統に対して、300 ppm の BA (6-benzylaminopurine) 処理を行った。その後、加温長日長のビニルハウスで栽培すると、BF-04, BF-08, BF-13 系統においては開花が約半月促進されたが、BF-20 系統では BA 処理による効果は認められなかった。無加温自然日長のビニルハウスで栽培した場合でも、BA 処理により BF-08 系統および BF-13 系統の開花が促進された。BA 処理は開花に必要な低温遭遇を代替

し、その結果 BA 処理された植物は不良な環境下でも生育できることが示された。

一方、無加温自然日長のビニルハウスでの開花は、GA₃ (gibberellic acid) 処理によっては促進されなかった。

このように、BF-08 系統および BF-13 系統のような低温要求性の小さい栄養系統を選抜し、BA 処理を行うことによって、秋から冬にかけての無加温自然日長ハウスでもシュッコンカスミソウの切花生産が可能になるものと考えられる。

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