島根大農研報 (Bull. Fac. Agr. Shimane Univ.) 22 : 16–21, 1988

Flower Bud Differentiation and Development of Tree Peony

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ボタンの花芽の分化と発達

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Flower bud differentiation and development of tree peony were investigated, using 3 cultivars of spring flowering type. Sepal differentiation started in the early July in 'Hanakisoi' and 'Taiyoh'. Petal differentiation started in the late September in 'Hanakisoi', and in the early October in 'Taiyoh' and 'Tamasudare'. Androecium differentiation started in the late October in 'Hanakisoi', and in the early November in 'Taiyoh' and 'Tamasudare'. Gynoecium differentiation started in the early November in 'Taiyoh' and 'Tamasudare', and then in 'Hanakisoi'.

The radial growth of flower bud in 3 cultivars almost completed at the late sepal differentiation stage or early petal differentiation stage, which corresponded with the starting time of chilling treatment for December flowering.

Introduction

It is important to investigate flower bud differentiation and development of various cultivars of tree peony (*Paeonia suffruticosa*) for realizing forced flowering in December. Hagiya (1960, 1961) reported that flower bud differentiation of 'Yachiyotsubaki' started in the end of July and the petal differentiation of 4 cultivars including 'Yachiyotsubaki' were noticed in the end of September.[1), 2)] However, the further development has not been observed, although in winter flowering type (*P. suffruticosa var. hiberniflora*) the gynoecium was already observed in the end of September.[2)]

Here, we investigated the further sequence of flower bud development and the relationship with radial bud growth, using 3 popular cultivars often used for forced flowering.

Materials and Methods

Three or four-year-old-grafted plants of 'Hanakisoi' (pink cv.), 'Taiyoh' (red cv.) and 'Tamasudare' (white cv.), which had been grown in Shimane University Field, were used for observation of flower bud differentiation and development. The terminal bud of each cultivar was taken about at intervals of 2 weeks from June 3 to

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December 23, 1985. The scale leaves were removed from the bud and the floral stage was determined based on observation under stereomicroscope. The diameter of the flower bud was also measured before and after removal of scale leaves. The numbers of sepals and petals were counted and the timing of androecium and gynoecium differentiation was checked. Five to six buds were used for each observation per cultivar.

Results and Discussion

In 'Hanakisoi', six immature leaves with marginal incision and a few leaf primordia were observed on June 3 and June 17, indicating that the buds were still at vegetative stage (Table 1 and 2). About 8 immature leaves and sepal primordia were noticed on July 1. The leaf number did not increase any more after July 1, but the sepal number continued to increase up to late September. On Sept. 24, it reached the final number (13–14) and the petals began to differentiate at the same time. A depression or cavity was observed in the center of the apex (Fig. 1). In October, the petal number increased on the periphery of the apex, the cavity still remaining undifferentiated. From the late October to early November, the androecium differentiated and on November 8, the gynoecium was observed in 3 samples out of 5. On December 10 and 23, approximately 30 petals were observed and the central cavity was completely filled with differentiated tissue (Fig. 2).

In 'Taiyoh', differentiation of petals and androecium started slightly later than 'Hanakisoi', but the timing of sepals and gynoecium differentiation was almost the

Table 1. Flower bud differentiation and development of 'Hanakisoi'

Observation date	Outer bud diameter (mm)	Inner bud diameter (mm)	Leaf number	Sepal[1] number	Petal number	Rate of androecium stage	Rate of gynoecium stage	Floral[2] stage
June 3	4.8	1.4	6.2	—	—	—	—	V
17	5.3	1.5	6.2	—	—	—	—	V
July 1	6.0	2.0	8.8	Primordia	—	—	—	S
16	6.3	2.4	8.0	3	—	—	—	S
30	7.0	2.4	8.0	5	—	—	—	S
August 11	7.5	2.9	8.0	5	—	—	—	S
26	7.2	3.1	8.6	6	—	—	—	S
Sept. 10	8.0	3.2	8.0	9	—	—	—	S
24	8.0	3.8	8.4	13	5	—	—	P
October 8	8.0	4.2	8.6	14	10	—	—	P
23	7.8	4.9	—	14	14	1/5	—	P/A
November 8	8.0	5.2	—	14	18	2/5	3/5	A/G
26	8.0	6.1	—	13	26	—	6/6	G
December 10	7.8	6.3	—	13	29	—	5/5	G
23	7.8	6.0	—	13	26	—	6/6	G

[1] Bract was also counted as sepal since both organs in peony were morphologically indistinguishable.
[2] V—vegetative, S—sepal, P—petal, A—androecium, G—gynoecium, respectively.

Table 2. The number of samples showing respective floral stage in 'Hanakisoi'

Observation date	Vegetative stage	Sepal differentiation	Petal differentiation	Androecium differentiation	Gynoecium differentiation
June 3	******				
17	****	**			
July 1		******			
16		******			
30		******			
August 11		******			
26		******			
Sept. 10		*****	*		
24		**	****		
October 8			*****		
23			****	*	
November 8				**	***
26					*****
December 10					******
23					******

Table 3. Flower bud differentiation and development of 'Taiyoh'

Observation date	Outer bud diameter (mm)	Inner bud diameter (mm)	Leaf number	Sepal[1] number	Petal number	Rate of androecium stage	Rate of gynoecium stage	Floral[2] stage
June 3	4.5	1.5	6.0	—	—	—	—	V
17	4.5	1.6	6.3	—	—	—	—	V
July 1	5.4	2.3	9.6	Primordia	—	—	—	S
16	5.6	2.2	9.6	Primordia	—	—	—	S
30	6.7	2.2	9.3	4	—	—	—	S
August 11	7.0	2.5	9.0	6	—	—	—	S
26	7.0	2.8	11.0	5	—	—	—	S
Sept. 10	8.0	3.2	11.0	6	—	—	—	S
24	7.8	3.2	9.8	8	—	—	—	S
October 8	8.3	4.0	10	11	14	—	—	P
23	7.7	4.3	—	12	15	—	—	P
November 8	7.8	5.2	—	10	20	1/6	5/6	A/G
26	7.8	5.8	—	12	26	—	5/5	G
December 10	7.6	6.6	—	11	30	—	5/5	G
23	7.8	7.0	—	11	30	—	6/6	G

[1] Bract was also counted as sepal since both organs in peony were morphologically indistinguishable.
[2] V—vegetative, S—sepal, P—petal, G—gynoecium, respectively.

Table 4. The number of samples showing respective floral stage in 'Taiyoh'

Observation date	Vegetative stage	Sepal differentiation	Petal differentiation	Androecium differentiation	Gynoecium differentiation
June 3	******				
17	******				
July 1	*	*****			
16	***	**			
30		*****			
August 11		*****			
26		*****			
Sept. 10		*****			
24		*****			
October 8			*****		
23			*****		
November 8				*	*****
26					*****
December 10					*****
23					******

Table 5. Flower bud differentiation and development of 'Tamasudare'

Observation date	Outer bud diameter (mm)	Inner bud diameter (mm)	Leaf number	Sepal[1] number	Petal number	Rate of androecium stage	Rate of gynoecium stage	Floral[2] stage
August 26	6.6	2.9	8.5	6	—	—	—	S
Sept. 24	7.3	3.5	8.8	13	—	—	—	S
October 8	7.5	4.0	9.0	15	11	—	—	P
23	7.5	4.6	—	16	17	1/5	—	P/A
November 8	7.8	5.2	—	14	19	—	4/4	G
26	7.8	5.2	—	13	26	—	5/5	G
December 10	7.6	5.5	—	12	22	—	5/5	G
23	7.8	5.0	—	12	26	—	5/5	G

[1] Bract was also counted as sepal since both organs in peony were morphologically indistinguishable.

[2] V—vegetative, S—sepal, A—androecium, G—gynoecium, respectively.

Table 6. The number of samples showing respective floral stage in 'Tamasudare'

Observation date	Vegetative stage	Sepal differentiation	Petal differentiation	Androecium differentiation	Gynoecium differentiation
August 26		****			
Sept. 10		*****			
24		***	***		
October 8			***		
23			****	*	
Nobember 8					****
26					*****
December 10					*****
23					*****

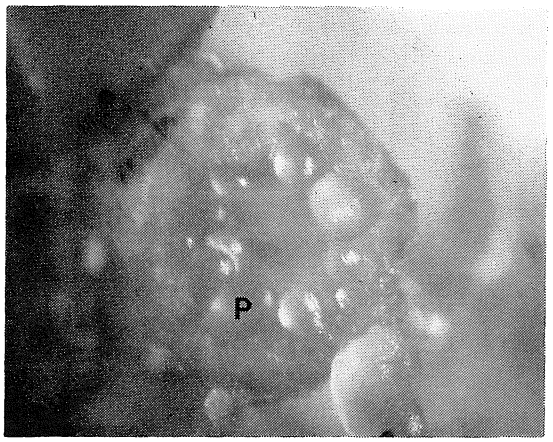

Fig. 1 Flower bud of 'Hanakisoi' showing petal (P) development and a cavity in the center of the apex (October 8).

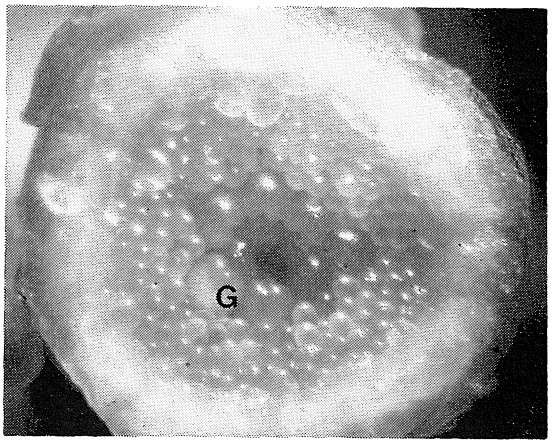

Fig. 2 Flower bud of 'Hanakisoi' showing a cavity filled with many petals, androecium and gynoecium (G) (December 23).

same as that in 'Hanakisoi' (Table 3 and 4).

In 'Tamasudare', for which the observation started later, the sepals were already differentiated by August 26. The start of petal differentiation was the same as that in 'Taiyoh', and the start of androecium, the same as that in 'Hanakisoi' (Table 5 and 6). The start of gynoecium differentiation was early November as in 'Taiyoh'.

Compared with Hagiya's observation (1960[1], 1961[2]), the differentiation of flower bud started a month earlier (july 1) in our place. This may be due to temperature difference between Niigata pref. (Hagiya's place) and Shimane pref. (our place). The former is located at cooler area where the flowering time is 2 weeks later (May 20). However, the perianth number in the middle September did not differ so much (approximately 6–10) between two locatios.[1]

In herbaceous peony (*P. lactiflora*), most of cultivars differentiated bracts and sepals in September and only one cultivar differentiated gynoecium in December.[3] This fact demonstrates that intiation and completion of flower bud in tree peony are much earlier than herbaceous peony. Compared with the other ornamental trees, the start of flower bud differentiation in tree peony is earlier than *Prunus mume* but later than *Camellia japonica*.[4] The timing of gyno ecium differentiation is similar to that in *Chaenomeles speciosa* (flowering quince).

For radial growth of bud in tree peony, an increase in outer bud diameter in 'Taiyoh' and 'Hanakisoi' terminated in the early September while that in 'Tamasudare', in the early October. This timing corresponds with the ending of sepal formation or the beggining of petal differentiation, which is also starting time of chilling for December flowering.[5] An increase in inner bud diameter, however, continued up to November in all the cultivars, suggesting that the outer frame of bud is formed first and then it is filled with differentiated tissues.

In conclusion, tree peony (spring flowering type) initiates flower bud in the middle summer, petals in the middle autumn, and gynoecium in the late autumn.

References

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摘　　要

ボタンの花芽分化発達が，春咲きの3品種を用いて調べられた．がくの分化は太陽と花競で7月初期に始まった．花弁の分化は花競で9月末に，太陽と玉簾では10月初期に始まった．雄ずいの分化は花競で10月末に，太陽と玉簾では11月初期に始まった．雌ずいの分化は太陽と玉簾で11月初期に始まりつづいて花競でみられた．

3品種の花芽の横径生長は，がく形成の終期または花弁形成の初期にほとんど止まった．またその時期は，12月開花のための冷蔵開始時期と一致した．