<Original Article>

STUDIES ON THE DIMORPHISM OF THE *PERSICARIA SENTICOSA* NAKAI *

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韓昶烈 : *Persicaria senticosa Nakai*의 *Dimorphism*에 關한 硏究

ABSTRACT

HARN, Chang Yawl (Chonnam U. Kwangju, Korea): *Studies on the dimorpism of the Perisicaria senticosa Nakai*——Kor. jour. Bot. 3(1) 16—25 During his researches regarding the morphological and physiological properties of Polygonaceae, the author has found that the species, *Persicaria senticosa*, aiso, besides the heterostylous plants of Polygonum family, *Fagopyrum esculentum*, and *Persicaria japonica* which was recently verified by the author as dimorphic, shows the typical floral structure of heterostylism, the description of which is not found in taxonomical works.

Further research on this species have revealed that this plant, despite pessessirg characteristic structural dimorphism, does not exhibit even the slight signs of heterostylous properties physiologically. This is a deviation from the usual behavior of normal heterostylous plants.

What is interesting is the fact that the physiological behavior of this species is quite contrary to that of *P. japonica* which is considered to be the most highly specialized dimorphic plant.

Thus it is assumed that if some species of this family had taken a heterostylic form in its course of development from autogamy to allogamy, *P. seoticosa* would be the least differentiated type of dimorphic forms among the three heterostylous plants, including buckwheat, of this family.

The results obtained in this experiment are summarized as follows:

1) *P. senticosa* has two forms of flower, one, long style-short stamened; the other, short style-long stamened. Not only conspicuous is this primary difference, but the secondary difference, such as pollen grain size, is noticeable between long and short styled individuals, thus expressing structurally the definite trait of a dimorphic plant.

2) Structural alteration of floral parts towards dimorphism has proceeded far less in comparison with those of the *P. japonica* and *F. esculentum*.

3) Elaborate studies on fertility reveal that this species dose not show the slightest sign of the physiological characteristics of dimorphic plants. In other words, regardless of the modes of combinations, legitimate and illegitimate, fertilization and fruit setting flourish unimpaired.

4) Growth of pollen tubes apparently parallels the results in the fertility, tubes reaching ovary approximately 30 minutes after pollination both in legitimate and illegitimate combinations. Pollen tube penetration appears to be comparatively rapid.

5) A slight difference in the growth of pollen tube seems to exist between legitimate and illegitimate combinations, legitimate union giving slightly faster tube penetration.

6) In the present experiment it was clarified that *P. senticosa*, known to possess one form of flower in taxonomy, is in reality dimorphic plant having two of flowers. Although this species is definitely heterostylous in floral structure, physiological evidence and pollen tube behavior show that the differentiation of this plant toward the dimorphism has apparently proceeded slightly except for some parts of floral organ. In ordinary heterostylous plants it is a matter of common occurrence that when illegitimately combined, there is poor or

no fertility, Contrary to the universal property of heterostylous plants, no difference is observed in the fertility and pollen tube growth between the legitimate and illegitimate combinations in the case of *P. senticosa*. Compared to the *P. japonica* and *F. esculentum*, whichare supposed to have undergone high degree of dimorphic differentiation, it is an unavoidable conclusion that *P. senticosa* has not yet developed as a heterostyle plant except for some of its floral parts. If *P. japonica* is assumed to be the most diffentiated type of heterostylous plant, thenthe *P. senticosa* would be regarded as the primitive, retaining still the self-fertile nature so common to the Polygonum genus. In nature, however, this plant has a better chance to be pollinated legitimately owing to the two forms of flowers than to be pollinated illegitimately.

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* *Polygomum senticosa Fr. & Sav.*

INTRODUCTION

The term "Heterostylism" is applied to the phenomenon in which there occur two kinds of individuals in the same species, one having long style-short stamened flowers and the other bearing the reverse form of flowers. The fact that an insect-pollinated plant has two, rarely three, kinds of heterostyle flower forms is supposed to be conductve to ensuring the cross-pollination rather than the self-pollination.

In the Persicaria (Polygonum) genus of Polygonaceae, strangely enough, there exist several species of heterostylous plants including the *Fagopyrun esculentum* (*Polygonum esculentum*) or buckwheat, well-known and widely studied, and *Persicaria japonica* and its varieties, all the forms of which are clearly dimorphic.

The author, during his research on the physiology of fertility of this family, happened to find out that *Persicaria senticosa*, described in the taxonomy as a species with a single form of flower, is actually a dimorphic plant. That is, there are two kinds of individuals, the flower of one form having a long styled and short stamen, and the other individual having a flower with a short style and long stamen. The level of the stigma in the long styled forms is approximately the same as that of the anthers in the short styled forms; and the level of the stigma in short-styled flowers is about the same as that of the anthers in long styled flowers.

In his brief experiment following the discovery of the dimorphism of this species, the author has found out that this plant, although heterostylous in floral structure, behaves quite differently in fertility from the common heterostylous plants so far investigated, and he has made further research, morphological and physiological. The results of this investigation reveal that this plant has certain physiological peculiarities as a heterostylous plant and its unusual behavior presents a significant meaning in the consideration of evolutionary processes when it is compared with the other heterostylous Polygonum species.

MATERIALS AND METHODS

The materials used in the present experiments were collected from various localities, and planted in the Wagner's pots.

Careful measurements of parts of floral structure were made in order to make clear the significance of difference between the two forms of flowers, i.e., the long-styled and short-styled flowers.

The operations of pollination and emasculation had to be performed with utmost care and elaboration as well as laborious perseverence because of the peculiarity of the flower which is tiny and is likely to be injured easily.

Castration was done, for the most part, in the early morning of the day when the pollination works are to

be performed, that is, just prior to the flower blooming, in order not to give injury to the floral parts.

Pollinations were made, in general, at 8:00-9:00 A.M. in summer months of July and August, but in the autumn months, delaying of the time of pollination was preferrable.

The fertility was determined, as a rule, by examining the swollen ovaries 4-6 days after pollination. In this plant no tendency of parthenogenesis or parthenocarpy was observed. All the fertilized flowers except two cases of embryo abortion attained their full maturity.

Microscopic examination of pollen tube was made by the following method:

Pollinated pistils were removed from the flowers and immediately fixed in the Carnoy's solution for 24 hours, then transferred to the hot lactophenol for the purpose of clearing the materials. After incubating in the lactophenol at approximately 60° C for 3-5 minutes, the pistils were stained in the hot Fuchsin lactophenol for 15-30 minutes. The stained materials were again transferred to the lactophenol and left there for several hours, until examinations were made, in order to destain the over-stained tissues so that the pollen tubes might be distinguished clearly. On the slide glass the pistils, ovaries being dissected out and cover glass placed on them, were squashed gently.

RESULTS AND DISCUSSION

I FLORAL STRUCTURE

The most conspicuous features in the heterostylous plants as a whole are that these kinds of plants have two kinds of individuals, one having the flower with a long-style and short-stamen, the other bearing just the reverse form of flower.

Usually in naturally cross-pollinated plants are observed various elaborate means by which the plants avoid the self-pollination, and accordingly self-fertilization. Examples of this phenomena are the dichogamy in crom or plantain, hercogamy in iris, self-incompatibility characteristic of the Brassica species of single genome, and other instances of mutual adaptability between floral organs and insects.

Heterostylism, like the various structural elaborations of flower organs just described, may be regarded as a means of effecting cross-pollination in nature.

In heterostylism the difference of the length of style, together with that of filament length, between long-styled and short-styled flowers, is called the primary difference, the outstanding characteristic from which the term, "Heterostyle" is derived.

In these kinds of plants, besides the length of style and filament, there frequently occurs differences, between the two forms of flowers, of pollen grain size, stigmatic outgrowth, and others, which are termed the secondary difference of heterostylous plants. Finding out that the *P. senticosa*, known as the plant with one form of flower, has actually two forms of flowers, one long-styled and the other short-styled, the frequency of their occurrence being approximately equal, the present author made further investigations on the morphological characteristics of flower structure and physiological behavior in fertility.

In the first place the flower organs were measured carefully and comparison between the two floral forms was made.

(1) Primary difference

a. Style length

The length of style is measured nearly two times longer in the long-styled flower as compared with that of short-styled flower.

Tab. 1 **Style length (mm)**

L	S
2,84±0,07	1,45±0,04

b. Filament length

Tab. 2 **Filament length (mm)**

L	S
1,34±0,01	2,32±0,03

The filament length, contrary to the length of style, is far longer in the short-styled individual, the ratio being approximately 1,7:1.

It is observed that in this species the level of the stigmas in long-styled flowers is almost the same as that of the anthers of short-styled flowers; and the level of stigmas in the short-styled flowers is about the same as that of the anthers in the long-styled forms. When insects visit the flowers of the plant, the pollination would be accomplished by the pollens of alternate forms of flowers rather than by those from the same forms of flowers. That is, in nature it is supposed that in this species there is a better chance for legitimate pollination than for illegitimate pollination to take place.

(2) Secondary differnce

Among the heterostylous plants, it is the common observation that there occurs such secondary differences as those of stigma shape, stigmatic outgrowth, and pollen grains between the two floral forms. In the two heterostylous Polygonaceae, *F. esculentum* and *P. japonica*, the secondary differences are remarkable. Notably in the latter species extreme differentiation is present.

The secondary differences in the floral organs of *P. senticosa* are given below:

a. Style diameter

Tab. 3 **Style diameter (mm)**

L	S
0,17±0,004	0,17±0,003

No difference in the style diameter between the long-styled flowers and short-styled forms is measured despite the noticeable difference in the length of style.

b. Stigma size

Tab. 4 **Stigma size (mm)**

Stigma, lengthwise		Stigma, crosswise	
L	S	L	S
0,15±0,003	0,19±0,006	0,14±0,002	0,12±0,003

The lengthwise diameter of short styles is larger than that of long styles. The crosswise diameter of stigma is, on the contrary, longer in the long styled individuals. It was observed that in the other two heterostylous Polygonum species, *F. esculeutum* (Polygonum) and *P. japonica*, there are marked differences in the stigma size of two forms of flowers, respectively. The stigmatic outgrowth which is so conspicuous in *P. japonica* is not present in both of the styles in this species.

c. Ovary size

Tab. 5 **Ovary size (mm)**

Ovary, Lengthwise		Ouary, crosswise	
L	S	L	S
0,75±0,016	0,77±0,022	0,64±0,016	0,59±0,041

No significant differences are measured in the ovary size, neither lengthwise nor crosswise, between the long

and short styled individuals. The external appearance of ovaries is exactly alike.

d. Filament diameter

Tab. 6 **Filament diameter (mm)**

L	S
0,12±0,003	0,12±0,004

Although the filament length of short styled flowers is much longer than that of long styled plants, diameters are just the same size. This condition is somewhat different from the other two dimorphic species of Polygonum genus.

e. Anther size

Tab. 7 **Anther size (mm)**

Anther length		Anther width	
L	S	L	S
0,61±0,01	0,63±0,01	0,47±0,01	0,46±0,01

The anther size of long styled plants, lengthwise and crosswise alike, is almost the same as that of the short styled individual. Marked contrast is observed concerning the anther size between the other two dimorphic Polygonaceae and this species, the short style anthers being far larger in the *F. esculentum* and *P. japonica*. Particularly in *P. japonica* the anthers of short-styled flowers appear to have become well developed, while in the long-styled flowers they shows signs of degeneration.

f. Pollen size

Tab. 8 **Pollen size (m)**

L	S
57,35±0,28	63,07±0,16

It has been found that the pollen grain size is definitely larger in short styled flowers than in long styled ones in any of the heterostyle plants so far investigated. This peculiar feature is not exceptional in *P. senticosa*. In heterostylous plants, the difference between long styled and short styled plants of style and filament length is termed as the primary difference; and the other floral structures are called the secondary differences.

In view of the outstanding trait that in this kind of plants the short style pollen is always larger, the author insists that the pollen grain size should be included in the category of primary difference.

The fact that the short style pollen is larger (and exclusively fertile in the case of *P. japonica*) suggests that with further specialization towards this direction, the short-styled individuals would finally alter to become male plants. This assumption would be more apparent when the investigation of the *P. japonica*, which is supposed to be the most differentiated heterostylous Polygonaceae in which the stamen of long-styled flower has undergone extreme alteration that not only the anthers and pollens show the sign of deterioration, but the pollens are physiologically sterile, is made.

In general, *P. japonica* shows the appearance that the development of short style anthers and pollen grains and the deterioration of long style pollen with the degenerated anther suggest the sign of alteration from dimorphism to dioecious. Although both the long and short styled flowers are perfect, the short styled individuals do not bear seed-setting in nature, a fact which has misled taxonomists to recognize the *P. japonica* as dioecious.

As described earlier, *P. senticosa* is a typical dimorphic plant morphologically with the characteristic differences, primary and secondary. The secondary difference, however, is not so remarkable as those of the *F. esculentum* and *P. japonica*.

P. senticosa is supposed to be far less differentiated ecologically, too. In *P. japonica*, the nectary gland is well deloped with swarming of insect-visitors, while in *P. senticosa* the reverse is the case. In *P. japonica* most of the long style pollen grains are sterile, whereas *P. senticosa* has complete fertile pollen both in long and short styled individuals.

II FERTILITY

In heterostylous plants the morphological floral structure, i.e., the occurrence of two kinds of flowers, long and short styles, is not only so constructed as if it offered more opportunities to effect cross-pollination rather than the self-pollination, but physiologically they show self-sterility of various degrees in most cases. When controlled hand pollinations are made, no or poor fertility is the result in self-pollination or pollination between like-styled flowers, while in the pollination between different forms of flowers good seed-formation is obtained. The author has named such kind of phenomenon as "Structural cross pollination-physiological self-sterility" which is supposed to be the most suitable term to express the fundamental features of heterostylous plants.

In these kinds of plants the mode of pollination and the behavior in fertility are outlined in the following formulas:

long-style x long-stamen
short-style x short-stamen) ..... fertile

long-style x short-stamen
short-style x long-stamen) ..... sterile

That is, when illegitimate combinations, in long and short styled individuals alike are made, poor fertilization or seed-setting is secured, whereas in the legitimately combined pollinations such as L x S and S x L good fertility is the result.

The morphological avoidance of self-pollination and physiological prevention of self-fertilization have been drawing much attention of investigators, the explanation on the mechanism of self-sterile phenomenon, however, having not been agreed upon. The physiological mechanism on self-incompatibility known to operate among horticultural plants may be applied in considering the self-sterile nature of heterostylous plants.

The variability in the self-sterile nature of heterostylous species, i.e., the degree of self-sterility, varies with the kinds of plants. For instance in Primula and Oxalis, well-known heterostylous species, the fact that they are self-sterile does not mean that they are of complete sterility, but it indicates that illegitimate combinations produce less seed-setting than the legitimately combined pollinations. This condition is a little more different in the case of *F. esculentum* in which the self-sterility is much more serious, producing almost no seed(2-6%) in illegitimate union. In the studies of *P. japonica* it has been found out that this species has completely lost the self-fertile property, producing absolutely no seed in illegitimate combinations. As stated above, in heterostylous plants although there exists common physiological property that legitimate pollinations produce more seed and illegitimate unions set poorly, the degree of self-sterile nature inillegitimate union varies in different species.

In order to detect how the *P. senticosa*, recognized as the dimorphic plant in the researches of flower structure, behaves in the fertilization and seed-formation when legitimate and illegitimate combination are practiced, various controlled pollinations such as "left wrapped", "left wrapped after emasculation", selfed, cross between like styles, and legitimate pollinations, both in long and short styles, were made.

In both long and short styled flowers, no ovary swelling or seed-formation was obtained when the flowers were left wrapped after castration. It is clear from this experiment that no parthengenetic or parthenocarpic phenomenon occurs in this species.

There is certain amount of seed-setting, notably more in short-styled flowers, when the flowers of each style

were left bagged with no emasculation. In longstyled flower the stigma which stands at higher level than the anther would allow the pollen of the same flower few chances to alight on it under wrapped condition.

When illegitimate combinations, selfing, L x L, S x S, in long and short style alike, were made, good fertility and seed formation were secured. Almost similar amount of fertility or seed-setting is the result in case of legitimate unions, L x S and S x L. In other words, in this species, as fertility or seed-formation is concerned, legitimate and illegitimate combinations produce similar results. As no statistical treatments were made,

Tab. 9 **Fertility (Aug. 3-15, 1959)**

Comb.	Flower pollinated	Ovary swollen	%	Seed matured	%	Remarks
L wrapped after cast	26	0	0	0	0	
L1 wrapped without cast.	21	4	19,0	4	19,0	
L2 wrapped without cast.	7	0	0	0	0	
L1 selfed	32	11	34,4	11	34,4	
L2 selfed	7	2	28,6	2	28,6	
L1 x L	19	9	47,4	9	47,4	
L2 x L	6	3	50,0	3	50,0	
L1 x S	25	11	44,0	11	44,0	
L2 x S	4	2	50,0	2	50,0	
S wrapped after cast.	36	0	0	0	0	
S1 wrapped without cast.	11	5	45,5	5	45,5	
S2 wrapped without cast.	11	4	36,3	4	36,3	
S3 wrapped without cast.	19	4	21,0	4	21,0	
S1 selfed	9	6	66,7	5	55,6	one emdryo abortion
S2 selfed	5	4	80,0	4	80,0	one embryo abortion
S3 selfed	17	7	41,2	6	35,2	
S1 x S	9	5	55,6	5	55,6	
S2 x S	9	3	33,3	3	33,3	
S3 x S	12	6	50,0	6	50,9	
S1 x L	14	6	42,8	6	42,8	
S2 x L	17	7	41,2	7	41,2	
S3 x L	17	8	47,1	8	47,1	

the significance of the differnence between the modes of combinations is not given here. The facts that almost equal fertility is obtained regardless of the modes of pollinations are illustrated in the results shown at Tab. 10,11.

Tab. 10 **Fertility of long style (1955-1959)**

Comb.	Flower pollinated	Flower fertilized	%
Strictly self pollination	530	169	31,9
Neighbor pollination	315	107	33,9
L X L	280	117	41,8
L X S	545	190	34,7

Tab. 11 **Fertily of short style (1955-1959)**

Comb.	Flower pollinated	Flower fertilized	%
Strictly self pollination	145	59	40,9
Neighbor pollination	171	54	31,5
S X S	236	94	39,8
S X L	481	192	40,0

These results regarding the fertility apparently lead to the conclusion that although *P. senticosa* is structurally dimorphic as its floral organ indicates, no physiological differentiation, as far as fertility is concerned, which is the characteristic in most of heterostylous species, has taken place yet. That is to say, physiologically this species is different, in part, from other heterostylous plants.

It has been found during the author's investitagion on the fertility of Polygonaceae that the non-heterostylous Polygonum species have the common nature of partially allogamous autogamy except for the three species of dimorphic plants so far mentioned. That is, most of the non-heterostylous Polygonum genus are naturally self-fertile although foreign pollens from different individuals are carried occasionally owing to the slightly developed nectary gland.

From the results obtained above, it is assumed that the *P. senticosa*, though morphologically differentiated into the heterostylism, has not altered physiologicaly, still retaining wholly the self-fertile nature characteristic of the non-dimorphic species of Polygonum genus.

In contrast to the *P. japonica* which appears to have undergone extreme dimorphic differentiation and to have lost completely the original self-fertile property of non-dimorphic *Persicaria* species, this species, *P. senticosa*, which still maintains the self-fertile nature, seems to give significant evidence for the consideration of the evolutionary process of heterostylous species in the Polygonaceae. In this species although the fertility under controlled pollination is similar in the two modes of combinations, legitimate and illegitimate, in nature there should be more opportunities for legitimate pollinations to ocdur than the illegitimate unions due to the facts that this plant has two forms of flower types and is insect-pollinated.

Ⅲ POLLEN TUBE

(1) The growth of pollen tube

It was observed in dimorphic *persicaria* species that in the illegitimate combinations such as selfing or crossing between like-styles the growth of the pollen tubes was checked at certain regions of stigmatic or style tissue, while in the legitimate unions, L × S and S × L, the tubes reached the ovaries without being checked. In *F. esculentum*, when the stigmas were pollinated with pollens from legitmate flowers, the pollen tubes reached the ovary in 15 minutes; but in the illegitimate combinations the pollen tubes were checked at the fixed areas of the styles……at the stigmatic tissues in the case of short-styled individuals and at the style in the long-styled individuals……when observed tens of hours after pollination. In *P. japonica* the pollen tubes reached the ovary within 40-50 minutes in the crossing of L × S and S × L, while in the illegitimate unions the growth of pollen tubes was observed checked at the fixed regions.

In the examinations of the growth of pollen tube of *P. senticosa*, it has been observed that regardless of the modes of pollinations the pollen tubes reached the ovary within I hour, that is, in both legitimate and illegitimate combinations in long and short styled individuals alike, the pollen tubes appeared to have no trouble in reaching the ovaries.

Tab. 12 **Pollen tube growth** (1,00 hr, after Pollination)

	L selfed	L x L	L x S	S selfed	S x S	S x L
Region tube checked	Ovary	Ovary	Ovary	Ovary	Ovary	Ovary
Average tube length(mm)	2,900	〃	〃	1,600	〃	〃

The behavior of the pollen growth of this species is quite peculiar when compared with the other dimorphic *Persicaria* species where the growth of the pollen tubes was in general checked when illegitimately pollinated. The behaviors of the pollen tubes are just identical to the results obtained in the experiment of fertility in which legitimate and illegitimate combinations alike produced equally good seed-setting, suggesting that in this

species there still has not proceeded the self-incompatible differentiation so characteristic to the heterostylous plants, and still has retained much of the self-fertile nature common to the non-dimorphic Polygonum species.

(2) The rapidity of pollen tube growth

The pollen tube growth seens to be relatively rapid in this species, reaching the ovaries in 30 minutes in any of the combinations, legitimate and illegitimate. The tube growth in the legitimate combinations whether the flowers are long or short styled, tends to be somewhat rapid in comparison with the cases of illegitimate union. It may be said that as a rule pollen tubes are able to grow down the entire style in 24-25 minutes in the unions of L x S and S x L. As the rapidity of pollen tube growth was not measured precisely, accurate results are not presented. But if the tube growth in the legitimate pollinations is supposed to be a little more rapid than in the illegitimate combinations as mentioned above, it may be stated that there has arisen more or less the physiological differentiation between legitimate and illegitimate combinations as far as pollen tube growth is concerned.

Tab. 13 **Tube penetration (Aug., 1939)**

Combination	Intervals after pollination		
	10 min.	20 min.	30 min.
L selfed	0,400mm* upper part of style	0,900 one-third of style	Ovary
L x L	0,400mm upper part of style	0,900 one-third of style	Ovary
L x S	0,500mm upper part of style	2,000 four-fifths of style	Ovary
S selfed	0,360mm one-fouth of style length	0,730 a half of style length	Ovary
S x S	0,360mm 〃	0,730 〃	Ovary
S x L	0,400mm one-third of style length	1,200 four-fifths of style	Ovary

* pollen tube length given in this table is not the average length based on careful measurements of each pollen tube, but the rough estimates based on the positions of average pollen tubes in the style.

As the examinations of the minor differentiation, however, concerning the fertility and pollen tube growth in the various combinations are not considered to be significant in the present researches, they are not taken into consideration seriously.

Through the series of experiments concerning the present species, *Persicaria senticosa*, it has been found that this plant, described in taxonomy as one-formed flower, is in reality a typical dimorphic plant morphologically. Physiologically, however, there exist no signs of dimorphism in which legitimate combinations of either L xS or S x L exclusively produce good fertility, still completely retaining the self-fertile nature of common non-heterostylous *persicaria* species; the behavior of pollen tube exactly corresponds to the results of fertility.

In other dimorphic species of polygonaceae *P. japonica* and *F. esculentum*, both the morphological differentiation between the two kinds of styles and the physiological behavior in regard to the fertilization have undergone extremely profound changes and there is much difference in the extent of alteration toward dimorphism between these two species and the *P. senticosa* with which the present paper is concerned. It is assumed that if the former two species, *P. japonica* and *F. esculentum*, are considered as the advanced type in the discussion of heterostylous plants, the latter species, *P. senticosa*, would be the most primitive type, still possessing physiologically the original nature of non-dimorphic *persicaria* genus.

摘 要

여뀌科植物(Polygonaceae)의 受精關係 特히 其中 Heterostyle 植物을 硏究해 오든中 *Persicaria senticosa*가 分類學에서는 1型花로 取扱되고 있지만 實은 2型花로 되어 있는것을 發見하고 L株, S株에 對해서 그 形態, 受精生理等을 調査해 보았드니 이 植物은 花器構造上으로는 典型的인 異型蕊植物이지만 受精生理 및 花粉管의 行動等으로는 아직 異型蕊植物로의 分化가 거이 안되고 非異型蕊의 一般 Polygonum (Persicaria) 屬 大部分의 特徵인 部分的 他家受精인 自家受精植物의 性質을 거이 全部 保有하고 있는 特殊型의 異型蕊植物이라는 것이 明白히 되었다. 實驗結果의 槪要를 말하면 다음과 같다.

1) *P. senticosa*는 花柱長, 花絲長 等 第一次的 差異가 L, S株間에 顯著할 뿐만 아니라 二次的 差異에 있어서도 花粉粒大 같은것은 L, S株間에 分化가 甚히 生겨 뚜렷한 異型蕊植物로 되어 있다.

2) 그러나 同科의 Heterostyle 植物인 *P. japonica*나 *Fagopyrum esculentum*에 比하면 아직 形態的으로 훨씬 未分化狀態에 있다.

3) 生理的으로는 長柱花(L), 短柱花個體(S)에서 다 分化가 아직 生겨서 適法, 不適法授粉을 莫論하고 受精, 結實이 다 같은 程度로 잘된다.

4) 花粉管伸長은 適法授粉, 不適法授粉에서 다 授粉後 30分이면 子房까지 到達되는데 比較的 伸長速度는 빠른 便이다.

5) 伸長速度는 適法授粉時가 不適法授粉時보다 더 速한 傾向이 있다.

6) 이 植物은 形態上으로는 長柱花, 短柱花의 2型花植物로 되어 있지만 其他의 形態, 生態, 生理的分化는 아직 뚜렷하게 되어 있질않아 Heterostyle 植物中에서도 特異한 現象을 나타내고 있는데 이것을 같은 여뀌科의 異型蕊植物과 比較를 해보면 *P. japonica* 같은 것은 가장 L, S株間이 分化가 甚하게 되어 있는데 反하야 이 *P. senticosa*는 花柱長, 花絲長, 花粉粒大 以外에는 아직 分化가 되어 있질 않은 特殊型의 異型蕊植物이라고 볼수가 있다. 萬一 *P. japonica*를 進化型이라고 假定하면 *P. senticosa*는 原始型이라 하겠고 *F. esculentum*은 移行型이라고 볼수가 있다.

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