

<ARTICLE> 한국산 구절초부리의 세포분류학적 연구; (2) 배수성

李永魯

(梨花女子大學校 文藝科大學 生物學科)

## A Cytotaxonomic Study on *Chrysanthemum zawadskii* Complex in Korea

### (2) Polyploidy

Lee, Yong No

(Dept. of Biology, Ewha Womans University)

### ABSTRACT

This study was made on the taxa *Chrysanthemum zawadskii* complex that grow in South Korea on the basis of chromosomes, epidermis, pollens and gross morphology. I have found four types of chromosome numbers, 36, 45, 54, and 72 as a polyploidal series.

Even though the gross morphology was quite similar almost the same gross morphology, chromosome number was different among the taxa. The taxa of 36 chromosomes present broad and fine lobed leaves which grow separately, broad leafed taxon in the mainland of Korea and the other's in Ullungdo Island which is isolated from the mainland in the East Sea. The taxa of 54 chromosomes are also present in the broad and in the fine lobed leaves. The fine lobed leaf taxon grows in central to northern Korea and in the high altitude of mountains. Broad leafed taxon grows in central to southern Korea and comparatively lower altitude of the mountains. The taxon of 72 chromosomes is grown in the high altitude of Mt. Hallasan which is isolated from the mainland of Korea.

According to this study of *Chrysanthemum zawadskii* complex, I have arranged the scientific names, as *Chrysanthemum zawadskii* subsp. *latilobum*, subsp. *acutilobum*, subsp. *naktongenese*, subsp. *lucidum*, subsp. *coreanum* and hybrid between subsp. *acutilobum* X subsp. *latilobum*.

### INTRODUCTION

Tahara, M (1965) reported cytological studies on *Chrysanthemum* and found polyploid series in the Japanese taxa.

In 1935, N. Shimotomai and K. Hara reported 27 chromosomes in pollen mother cells from *Chrysanthemum* collected in the area of Kongju, Province of Chung chong namdo.

Han, Changyel (1965) reported the chromosome number studies on the wild *Chrysanthemum*.

Recently, Shimotomai, Takahara and Shimiz (1961, 1921, 1961) reported 54 and 72 chromosome number in the somatic cells of *Chrysanthemum zawadskii* groups.

In 1967, Lee reported natural hybridization between *Chrysanthemum zawadskii* subsp. *acutilobum* and *C. zawadskii* subsp. *latilobum*. The aim of this study is to report on an investigation

conducted on the wild *Chrysanthemum zawadskii* complex chromosomes in Korea since 1964.

I wish to thank sincerely to Miss Yong Cha Oh, a graduate student, Dept. of Biology, Ewha Womans University and Yoo Sung Lee, a graduate student, Yonsei University who helped in making slides and counting chromosomes. Thanks are also extend to whom helped in material plants collection of the study.

### MATERIALS AND METHODS

*Chrysanthemum* (usually white flower) materials that had been transplanted from over sixty places in South Korea to Ewha Botanical Garden were used for the investigation. Collected areas and collectors are as follows: (Table I).

Table I.

Locality	Chromosomes	Altitude	Rocks	Collectors
Prov. Kyonggido				
Mt. Bulamsan	2n=36	200m	Granite	Y. N. Lee
Mt. Hwaaksan	2n=54	1400	Crystal Schist System	Y. N. Lee
Kunja	2n=54	50	"	Y. N. Lee & Y. C. Oh
Kojedo	2n=54	20		M. K. Park
Kwangnung	2n=36	50	Granite	Y. N. Lee
Kwangwhado	2n=54	200	"	Y. N. Lee & Y. S. Lee
Myojangdong	2n=54	30	Porphyry	Y. N. Lee
Punmunjom	2n=54	30	Granite	Y. N. Lee
Seoul	2n=36 2n=54	50	Granite	Y. N. Lee
Yuju	2n=54	200	Granite	C. W. Lee
Yongin	2n=54	50	"	Y. N. Lee
Prov. Kangwondo				
Mt. Baekamsan	2n=54	1000	Andesite	Y. N. Lee & Y. S. Lee
Mt. Daeamsan	2n=54	1200	"	Y. N. Lee & Y. S. Lee
Pas. Daekwan-ryong	2n=54 2n=36	1000 1000	Granite "	Y. N. Lee & Y. S. Lee
Mt. Daeuoosan	2n=54	1100	Andesite	Y. N. Lee
Wonju	2n=54	100	Granite	C. W. Lee
Hwachun	2n=36 2n=54	300 300	Crystal Schist System	Y. N. Lee
Hwajinpo	2n=54	100	Granite	Y. N. Lee & Y. S. Lee
Hyangnobong	2n=54	1200	"	Y. N. Lee & Y. S. Lee
Kangnung	2n=36	100	"	Y. N. Lee
Naksansa	2n=36	100	"	Y. N. Lee
Punchbowl	2n=54	1000	"	Y. N. Lee
Mt. Soraksan (Bisonda)	2n=54	1000	"	Y. N. Lee
(Daesungryong)	2n=36	300	"	Y. N. Lee

(Daechungbong)	2n=54	1700	"	Y. N. Lee & Y. S. Lee
(Madungryong)	2n=54	1000	"	Y. N. Lee
Prov. Chungnam				
Doksan	2n=54	100	Granite	Y. N. Lee
Kongju	2n=54	100	Crystal Schist System	C. H. Kim
Nampo	2n=54	200	Daedong System	Y. N. Lee
Yesan	2n=54	500	Andesite	Y. C. Cho
Prov. Chungbuk				
Miwon-ni	2n=54	50		Y. C. Oh
Okchon	2n=54	100	Granite	B. S. Yuk
Soknisan	2n=54	1000	"	Y. C. Oh & B. S. Yuk
Prov. Chollabukdo				
Chonju	2n=54	200	Schistose Granite	O. C. Kim
Iri	2n=54	100	Granite	Y. H. So
Kuchondong	2n=54	300		M. C. Park
Kunsan	2n=54	100	Crystal Schist System	Y. N. Lee
Prov. Chollanamdo				
Chujado	2n=54	50	Porphyry	W. C. Lee
Haenam	2n=54	200	Schistose Granite	Y. N. Lee
Kwangju	2n=54	500	Dorite	K. C. Lee
Mokpo	2n=54	100	Porphyry	Y. N. Lee
Namhae	2n=54	300	Silla Series	Y. N. Lee
Nokodam	2n=54	1700	Granite Greiss System	Y. N. Lee
Prov. Kyongnam				
Changchon	2n=54	100	Granite	Y. N. Lee
Haeundae	2n=54	50	Nakton Series	Y. N. Lee
Kayasan	2n=54	200	Crystal Schist System	Y. N. Lee
Kochang	2n=54	100	Granite	Y. N. Lee & E. L. Tyson
Masan	2n=54	150	Dorite	Y. A. Lee
Tongnae	2n=54	50	Silla	Y. N. Lee
Yangsang	2n=54	200	Granite	Y. N. Lee
Yongdo	2n=54	100	Silla	Y. N. Lee
Prov. Kyongbuk				
Kuryongpo	2n=36	100	Porphyrite	Y. N. Lee
Mt. Pallkongsan	2n=54	1000	Dorite	Y. N. Lee
Mt. Pohyonsan	2n=36	1000	Silla	Y. N. Lee
Mt. Toamsan	2n=36	700	"	Y. N. Lee
Yonghae	2n=36	100	"	Y. N. Lee
Prov. Ullungdo				
Naridong	2n=36	800	Rhyolite	Y. N. Lee & M. K. Park

Prov. Chejudo Mt. Hallasan	2n=72	1200	Basalt	Y. N. Lee & C. A. Do
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For cytological studies, root tips were pretreated with 0.002 mol. hydro-oxyquinoline for 3.5 hours at room temperature, and the squashing method was employed with one percent acetic orecein solution. Chromosomes were observed with the Olympus microscope at magnification of 1,000 times.

## OBSERVATION

The taxa of the plants usually grow from hills to mountain tops in the open area on reddish clay, corroded granite soils and loams (Table I).

The leaves of the taxa present various types of gross morphology, broad and shallow lobed leaves to narrow and finely lobed leaves (Plate I). The epidermal patterns are not distinctly differentiated among the taxa. The stomata were found to be of variable sizes (Table 2) Plate 2).

Table 2. Stomata of *Chrysanthemum* (abaxial)

		length (microns)		width (microns)
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>latilobum</i>				
Hwachon	2n=36	43.9	X	26.8
Seoul (Bulamsan)	2n=36	42.5	X	31.1
Seoul (Ewha)	2n=36	44.1	X	30.0
Naksansa	2n=36	44.0	X	31.0
Mt. Soraksan	2n=36	42.3	X	32.3
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>latilobum</i> X <i>C. zawadskii</i> Herb. subsp. <i>acutilobum</i>				
Seoul (Ewha)	2n=45	46.2	X	28.8
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>lucidum</i>				
Ullungdo	2n=36	48.9	X	33.7
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>acutilobum</i>				
Mt. Soraksan	2n=54	47.0	X	31.3
Mt. Hwaaksan	2n=54	54.3	X	37.5
Seoul (Ewha)	2n=54	44.0	X	30.0
Mt. Daeamsan	2n=54	51.1	X	28.6
Hyangnobong	2n=54	53.6	X	32.1
Pas. Daekwanryong	2n=54	54.0	X	38.0
Kwanmubong		46.0	X	29.0
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>naktongense</i>				
Kongju	2n=54	46.8	X	30.2

Mt. Nokodam	2n=54	47.7	X	30.3
Kunsan	2n=54	48.7	X	26.6
Mokpo	2n=54	43.6	X	25.7
Mt. Palkongsan	2n=54	43.2	X	29.3
Yongdo	2n=54	40.3	X	28.4
Haenam	2n=54	43.8	X	31.7
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>coreanum</i>				
Mt. Hallasan (Chejudo)	2n=72	53	X	36.0

※ average length and width of 20 stomata

Pollen grain size and shape were not much variable, but the pollen sizes of Cheju taxa were much larger than the others (Table 3).

Table 3. Pollen size of *Chrysanthemum zawadskii* complex

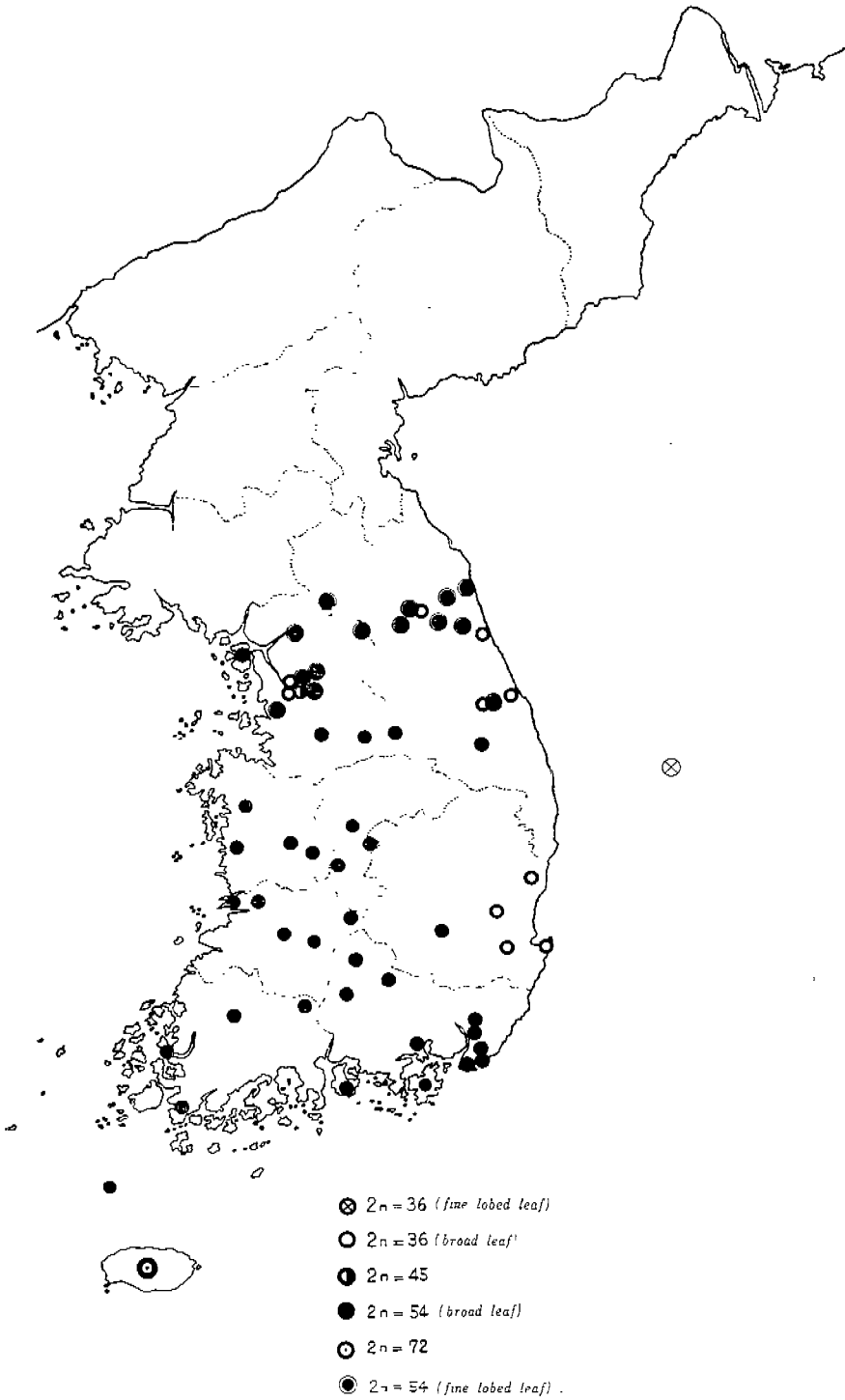
	Chromosomes	Pollens
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>latilobum</i>		
Seoul (Ewha)	2n=54	29.0 (microns)
Seoul (Bulamsan)	2n=36	30.5
Mt. Soraksan	2n=36	30.5
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>lucidum</i>		
Ullungdo	2n=36	29.5
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>latilobum</i> X <i>C. zawadskii</i> Herb. subsp. <i>acutilobum</i>		
Seoul (Ewha)	2n=45	31.0
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>acutilobum</i>		
Seoul (Ewha)	2n=54	32.0
Mt. Soraksan	2n=54	30.7
Mt. Paektusan	{ Completely dry Specimens }	2n=?
Mt. Diamond	2n=?	27.0
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>naktongense</i>		
Chonju	2n=54	29.0
Haenam (Daehungsa) (White flower)	2n=54	30.7
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>coreanum</i>		
Mt. Hallasan	2n=72	34.0

※ average length of 20 pollens

Fertilities of principal taxa were as following;

*Chrysanthemum zawadskii* Herb. subsp. *latilobum* 2n=36 broad leaved

Fig. 1. Distribution of *Chrysanthemum zawadshii* complex in Korea



		Whachon.....	96.2%
		Bukaksan.....	81.2%
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>lucidum</i>	2n=36 finely lobed leaf		
		Ullungdo .....	92.4%
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>acutilobum</i>	2n=54 finely lobed leaf		
		Soraksan (Bisondae) .....	93%
		Soraksan (Top) .....	75.3%
		Daeamsan .....	93.7%
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>nakdongense</i>	2n=54 broad leaved		
		Kangwhado .....	95.5%
		Kuchondong .....	89.8%
<i>Chrysanthemum zawadskii</i> Herb. subsp. <i>coreanum</i>	2n=76		
		Chejudo .....	86.7%

Somatic chromosome number of the taxa is 36,45,54 and 72 (Table 3.4) (Plate 3) (Fig. I).

### DISCUSSION

The basic chromosome number of *Chrysanthemum* is 9 and the somatic chromosome number of 18, 36, 54, 72 and 90 are known (Tahara). The *Chrysanthemum* was included with native and foreign origin species, *Chrysanthemum arcticum* L., *C. carinatum* Schoub, *C. cornarium* L., *C. decaisneanum* Matsum., *C. japonicum* Makino, *C. lavandulaefolium* Makino, *C. leucanthemum* L., *C. marschallii* Aschers, *C. morifolium* Ram, and *C. nipponicum* Franch.

I have counted somatic chromosomes of *Chrysanthemum zawadskii* complex are as 36, 45, 54 and 72 numbers in South Korea. This results are present polyploidal series.

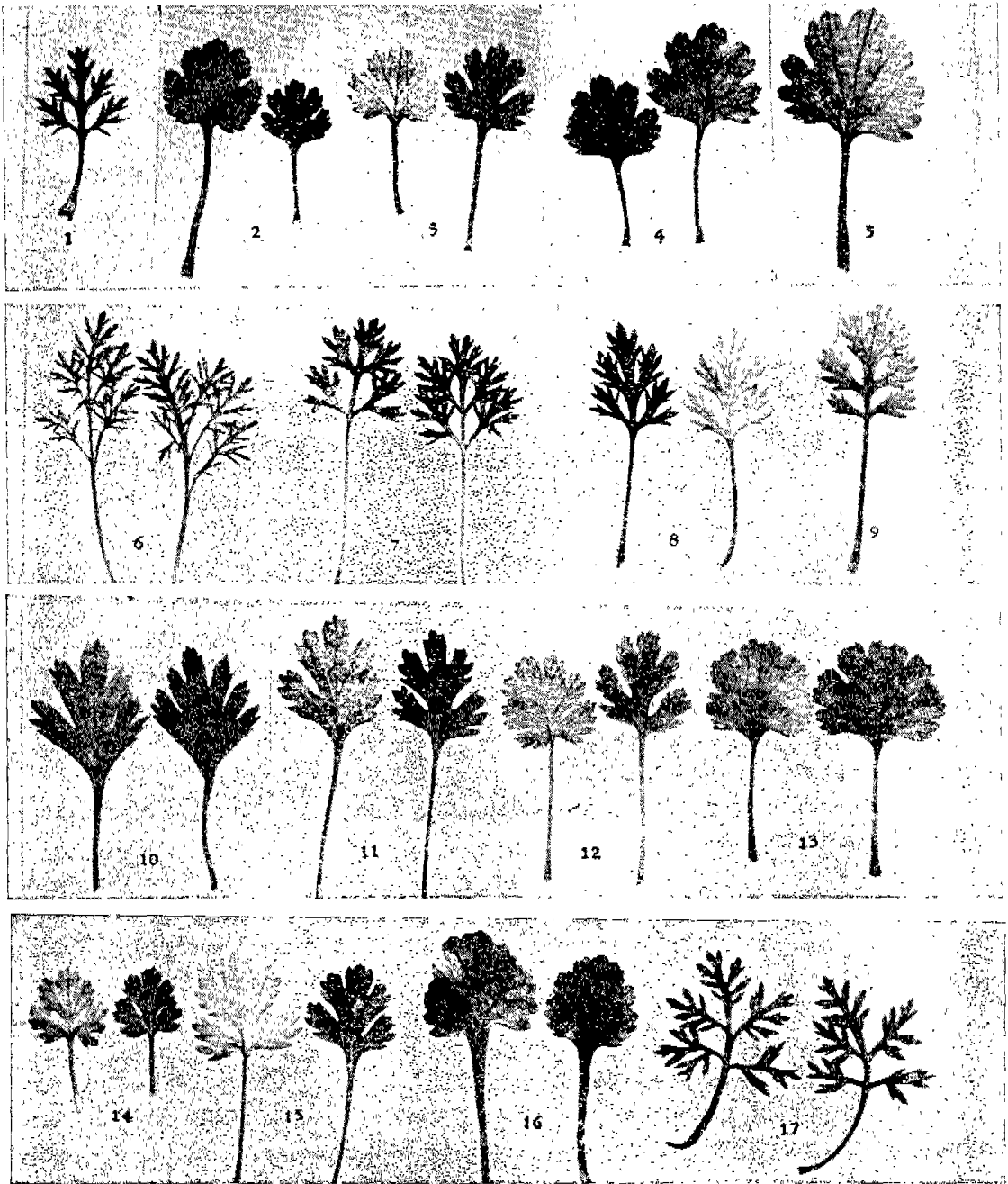
Japanese taxa of *Chrysanthemum zawadskii* complex show only 54 and 72 numbers (Shimotomai, Takahara and Shimiz).

The taxa of 36 chromosomes are grown principally in the Seoul area, Soraksan, Naksansa, Pohyunsan and Ullungdo (Fig. 1). The taxa show two types of leaves; the taxa of broad and shallow lobed leaves are grown in the mainland of Korea, central to east part of Korea, facing the Eastern Sea (Sea of Japan). The taxon of fine lobed and shiny leaves is grown in 800 m above sea level in Ullungdo Island.

The taxa of 54 chromosomes are widely distributed from central to southern parts of Korea. The taxa also show principally two types of leaves; broad leaves and fine lobed leaves. The taxon of fine lobed leaves is usually grown in the high altitude of the mountains in the central part of Korea. The taxon of broad leaves is grown in comparatively the low altitude of mountains from the central to southern parts of South Korea (Fig. I) (Plate 3).

The taxon of 45 chromosomes is grown only in Ewha Womans University campus which is a protected area for vegetation (Plate 3).

The taxon of 72 chromosomes is grown only above the 1,200m sea level of the Mt. Hallasan. The taxon is present finely lobed and fleshy leaves. The stomata and pollens are much larger than the others (Fig I Plate 1, 2, 3, 4).

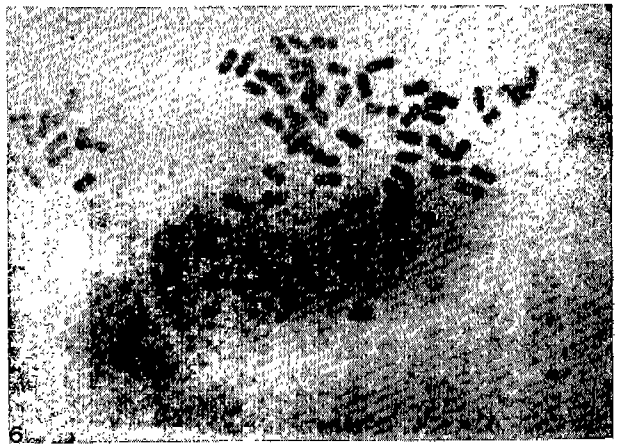
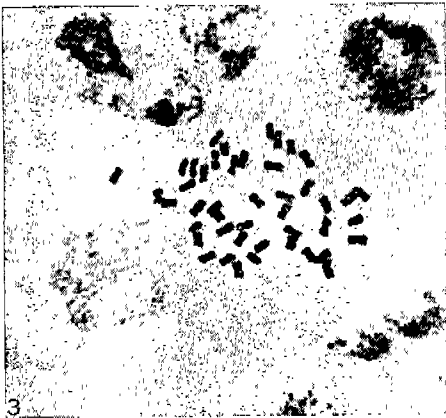
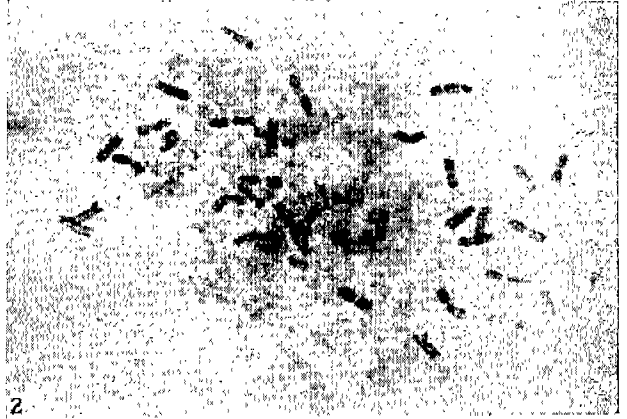
Plate 1. Basal leaf shape of *chrysanthemum zawadskii* complex

A. *Chrysanthemum zawadskii* Herb. subsp. *lucidum* (2n 36) 1. Ullungdo Island B. *Chrysanthemum zawadskii* Herb. subsp. *latilobum* (2n 36) 2. Naksansa 3. Seoul (Ewha) 4. Kuryongpo 5. Hwachon C. *Chrysanthemum zawadskii* Herb. subsp. *acutilobum* (2n 54) 6. Hyangnobang 7. Mt Soraksan 8. Kuncha 9. Kojedo Island

D. *Chrysanthemum zawadskii* Herb. subsp. *naktongense* (2n 54) 10. Yongin 11. Kuchondong 12. Kayasan 13. Chonju 14. Kumsan (Namhae) 15. Taechongdae (Yongdo) 16. Chujado E. *Chrysanthemum zawadskii* Herb. subsp. *coreanum* (2n 72) 17. Mt. Hallasan



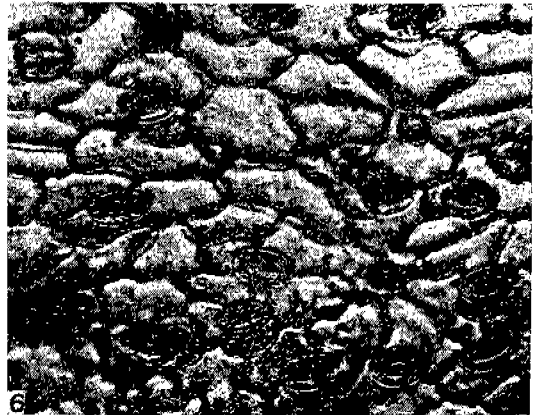
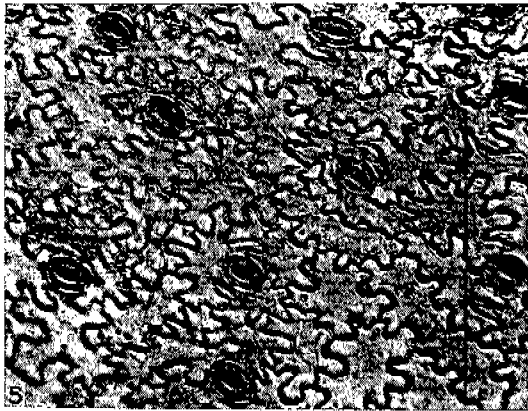
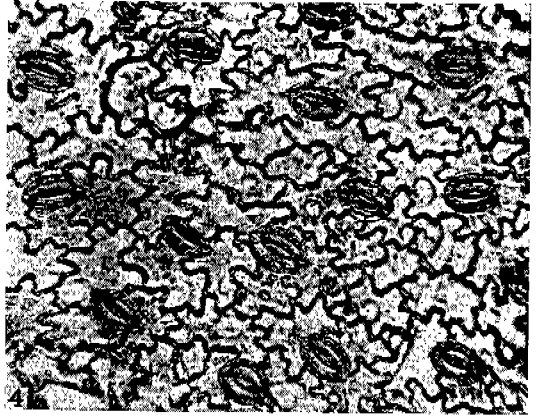
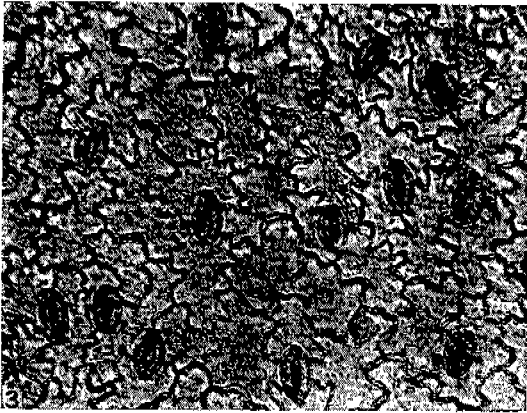
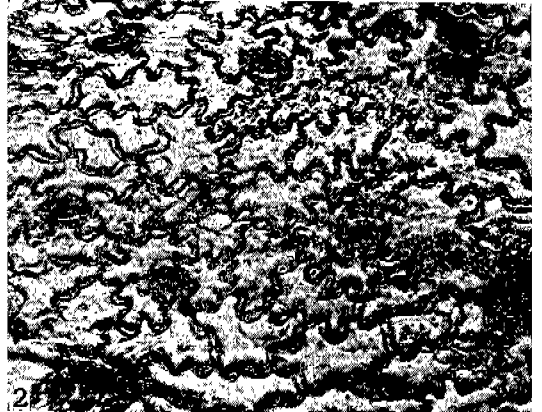
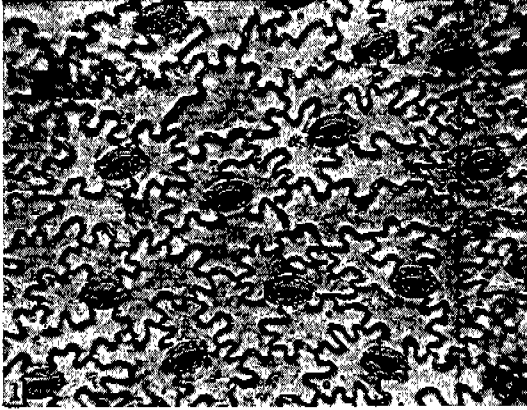
Plate 3. Chromosome Number of *Chrysanthemum zawadskii* Complex



- 1. *Chrysanthemum zawadskii* Herb. subsp. *latilobum* 2n=36
- 2. *C. zawadskii* Herb subsp. *lucidum* 2n=36
- 3. *Chrysanthemum zawadskii* Herb. subsp. *latilobum* X *C. zawadskii* Herb. subsp. *acu-*

- tilobum* 2n=45 ×1000
- 4. *Chrysanthemum zawadskii* Herb. subsp. *acu-*
- tilobum* 2n=54
- 5. *C. zawadskii* Herb. subsp. *naktongense* 2n=54
- 6. *C. zawadskii* Herb. subsp. *coreanum* 2n=72

Plate 2. Epidermis of leaf blade (abaxial)

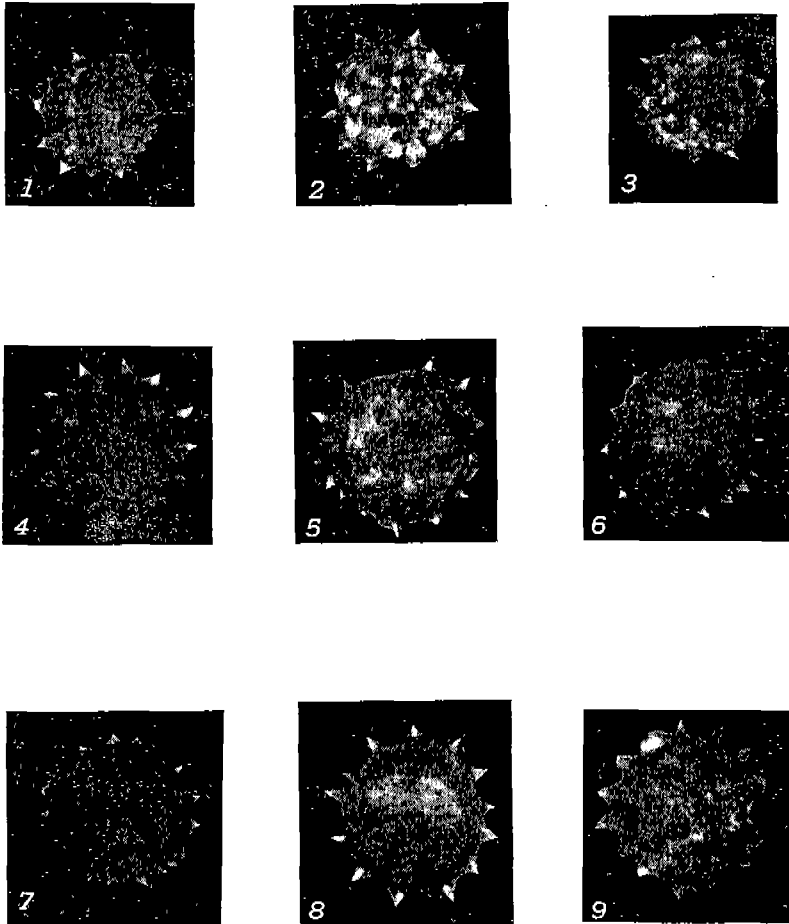


- 1. *Chrysanthemum zawadskii* Herb. subsp. *latilobum*
- 2. *C. zawadskii* Herb. subsp. *lucidum*
- 3. *C. zawadskii* Herb. subsp. *nakdongense* (Kongju)

- 4. *C. zawadskii* Herb. subsp. *acutilobum*
- 5. *C. zawadskii* Herb. subsp. *nakdongense* (Kunsan)
- 6. *C. zawadskii* Herb. subsp. *coreanum*

×150

Plate 4. Pollens of *Chrysanthemum zawadskii* complex



1. *Chrysanthemum zawadskii* Herb. subsp. *acutilobum* (2n=54 Paektusan)
2. *C. zawadskii* Herb. subsp. *acutilobum* (2n=54 Mt. Diamond)
3. *C. zawadskii* Herb. subsp. *acutilobum* (2n=54 Mt. Diamond)
4. *C. zawadskii* Herb. subsp. *latilobum* (2n=36, Seoul)
5. *C. zawadskii* Herb. subsp. *acu-*

- ×700
6. *C. tilobum* (2n=54, Seoul)
  7. *C. zawadskii* Herb. subsp. *lucidum* (2n=36, Ullungdo)
  8. *C. zawadskii* Herb. subsp. *nakto-*  
*ngense* (2n=54, Chonbuk)
  9. *C. zawadskii* Herb. subsp. *core-*  
*anum* (2n=76, Mt. Hallasan)
  9. *C. zawadskii* Herb. subsp. *core-*  
*anum* "

The gross morphology of the taxa are all alike, herbaceous, rhizomatous and principally white ray flowered head. Presumably the taxa of 36 chromosomes are more primitive than the other taxa. This taxa are Asian continental elements of *Chrysanthemum zawadskii* and they are established early in the geological era. The taxon of broad leaves is inland and original form, while the taxon of fine lobed leaves is ecological form of isolated Ullungdo Island.

The taxa, 54 chromosomes, are presumably originated from the taxon of 36 chromosomes. The taxon of fine lobed leaves is a well adapted form for the high altitude of the mountains and sea sides in the central parts of Korea. The taxon of broad leaves is ecotype of the lower land in southern Korea. The two types, broad and fine leaved taxa of 54 chromosomes, presumably originated from the same taxa of 36 chromosomes and are differentiated under the ecological differences.

The taxon of 45 chromosomes is presumed to be originated by the hybridization between the taxon 36 chromosomes and 54 chromosomes (1967).

According to the chromosomes, stomata, fleshy leaves, the taxon of 72 chromosomes is considered to be arised by autopoloidy mechanism, and this taxon is well adapted to the high altitude area of Mt. Hallasan in isolated Chejudo Island.

Unfortunately it is not possible to check the living taxa which grow in northern Korea. But the writer has studied the specimens of the taxon and confirmed the taxon present narrow and finely lobed leaves with more pubescent. This type of taxon usually grown in Mt. Paektusan, Kamumbong, Diamond, however, I have also found at the top of Mt. Soraksan and counted 54 chromosomes in the root tips. The taxon was transplanted to the lower land, the taxon lost the pubescent hairs. Kitagawa(1964) arranged the taxon scientific name as a *C. zawadskii* subsp. *zawadskii* var. *acutilobum* forma *alpina*.

According to the result of this study I have arranged the scientific names of the *Chrysanthemum zawadskii* complex as follow: *Chrysanthemum zawadskii* Herbich, Add. Fl. Galis. 43, (1831); Decandolle, Prodr. 6:97, (1837); Sealy in Journ. Roy. Hort. Soc. 13:268, (1938); Pax in Engler & Drude, Veget. Erde 10:145, (1938); Kitamura in Act. Phytot. Geobot, 7:210, (1938); Comp. Jap. 2: 360, (1940).

*Pyrethrum zawadskii* (Herbich) Nyman, Syll. Fl. Eur. 11, (1854-1855).

*Dendranthema zawadskii* (Herbich) Tzevlve in Fl. URSS 26:376, (1961).

subsp. *zawadskii*. Note: leaves rather finely lobed, chromosome unknown, but probably 54.

subsp. *acutilobum* (DeCandolle) Kitagawa 2n 54, Lineam. Fl. Manch. 444, 1939.

*Leusanthemum sibiricum* De Candolle var. *acutilobum* De Candolle, I.C. 46, (1837).

*C. sibiricum* Turczaninow ex De Candolle, I.C. (1837).

*C. zawadskii* var. *sibiricum* (Turczaninow) Sealy, I.C. (1938).

*C. sibiricum* var. *koreanomontanum* Nakai in Journ. Jap. Bot. 16:75, (1940).

*C. sibiricum* var. *alpinum* Nakai in Bot. Mag. Tokyo 31:109, (1917).

*C. zawadskii* subsp. *acutilobum* var. *sylvaticum* Kitagawa in Rep. Ins t. Sci. Rer. Manch. 6:128, (1942).

*C. zawadskii* subsp. *erubescens* f. *molle* (Uyeki) Kitagawa in Journ. Jap. Bot. Vol. 41, 6:192,

(1966).

Distr: Siberia, Manshuria, Korea and Japan.

Note: finely lobed leaves, somatic chromosomes are 54, pubescent, on high altitude forms (*C. sibiricum* var. *alpinum* Nakai).

subsp. *latilobum* (Maximowicz) Kitagawa, (2n 36) Lineam. Fl. Manch, 444 (1939).

*C. sibiricum* var. *latilobum* Maximowicz, Prim. Fl. Amur, 156, (1859).

*C. sibiricum* Turczaninow ex De Candolle, Prodr. 6. 46, (1837).

*C. chanetii* Leveille in Fedde, Repert. 9:450, (1911).

*C. leiophyllum* Nakai, I.C. 35:149, (1921).

*C. zawadskii* var. *latilobum* (Maxim) Kitamura, 11 cc. 210, (1938); Hara, Enum. Jap. 2:167, 1952; Ohwi Fl. Jap. ed 1:1186 (1961): ed. 2:1350, (1965).

Distr: Ussuri, Manshuria, Korea.

Note: broad and thin leaves, somatic chromsomes are 36, phenotypically, it is similar to *C. zawadskii* subsp. *naktongense*.

subsp. *naktongense* (Nakai) Y. Lee comb nov.

*C. naktongense* Nakai in Bot. Mag. Tokyo 23:186, (1909).

*C. sibiricum* var. *naktongense* (Nakai) Nakai in Jnurn. Jap. Bot. 16:73, (1940)

*C. naktongens* (Nakai) Tzvelev, I.C. 375, (1961).

*C. reflexum* Uyeki in suigen-gakuho 21:13, (1928).

Distr: Korea, Japan, Manshria.

Note: broad leaves rather thicker than the *C.z.* subsp. *latilobum*, somatic chromosomes are 54, can not sasily identify *C.z.* subsp. *acutilobum* and this taxa.

subsp. *lucidum* (Nakai) Y. Lee comb. nov.

*C. coreanum* Nakai, Bot. Mag. Tokyo 32, 110 (1918).

Distr: Isl. Ullungdo, Korea.

Note: deeply lobed and thickend leaves, adaxial surfaces shiny, somatic chromosomes are 36.

subsp. *coreanum* (Nakai) Y. Lee, comb. nov.

*C. coreanum* Nakai, Veg. Quelpart 88, (1914).

Distr: Isl. Chejudo.

Note: finely lobed and thickened leaves, somatic chromosome are 72.

*Chrysanthemum zawadskii* Herb. subsp. *latilobum* X subsp. *acutilobum*

Distr.: Ewha Womans University campus

Note: leaves are intermediate form of *C. zawadskii* Herb.

subsp. *latilobum* and subsp. *acutilobum*, somatic chromosomes are 45.

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### 摘 要

과거에 한국산 구절초의 세로분류학적인 연구는 전혀 없었다. 1964년부터 5년간에 걸쳐한 염색체 연구로서 배수성이 있는 것을 발견했다. 그리고 외부형태와 화분의 염도(稔度)를 조사했고 분포관계도 밝히어 종합적인 결론을 내리었다. 그 결과 염색체수가 36, 45, 54, 72 (4배, 5배, 6배, 8배)로 나타났다. 염색체수  $2n=36$ 으로 잎이 넓은것은 한반도의 중부와 동해안지역에 나는것으로 구절초 *Chrysanthemum zawadskii* subsp. *latilobum* (Max). Kitagawa 이다. 잎이 가늘게 쪼개지고 두껍고 반들반들한 것은 울릉도에 나며 염색체수는  $2n=36$ 이다. 이것은 울릉 국화라고 불리어지는 것으로 울릉 구절초 *Chrysanthemum zawadskii* Herb. subsp. *lucidum* (Nakai) Y, Lee 이다.

그리고 잎이 가늘게 쪼개지는 것으로 염색체수가  $2n=54$ 로된 것으로 중부 이북에 분포하는 것은 가늘 구절초 (바위 구절초) *Chrysanthemum zawadskii* Herb. subsp. *acutilobum* (De Candolle) Kitagawa 이며 잎이 넓은 것으로 염색체수가  $2n=54$ 인 것은 중부 이남에 널리 분포하는 것으로서 *Chrysanthemum zawadskii* Herb. subsp. *naktongenense* (Nakai) Y. Lee 이다. 염색체수가  $2n=72$ 로서 잎이 다육이며 제주도에 나는것은 제주구절초 *Chrysanthemum zawadskii* Herb. subsp. *coreanum* (Nakai) Y. Lee 이다. 한국에서는 구절초  $2n=36$ 이고 잎이 넓은 것에서 잎이 가늘것으로 또한  $2n=54$ , 72로 분화되어 왔을것으로 보는 바이다.