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Chromosome Counts from the Flora of Korea with Emphasis on Apiaceae

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Seventy-three chromosome counts are reported from populations in 70 species from Korea, of which 34 counts in 32 species belong to Apiaceae. New species counts are in *Acanthopanax chiisanensis* (2n=48), *Hydrocotyle japonica* (2n=ca. 96), *H. maritima* (n=12), *Libanotis coreana* (2n=22), *Lindera sericea* (n=12), *Quercus myrsinaefolia* (n=12), *Rhamnus yoshinoi* (n=12), *Salix hulteni* (n=19), *Symplocos chinensis* for. *pilosa* (n=11) and *Vaccinium oldhami* (n=12). New chromosome level for *Asperula odorata* (n=11), *Cryptotaenia japonica* (2n=16) and *Sium ninsi* (2n=18) is also provided. The taxonomic implications of certain of these counts are discussed.

Keywords: chromosome count, Korean flora, Apiaceae

The chromosome diversity within phytogeographic and/or ecological regions has been documented continuously, sometimes as a part of other floristic investigations. This can provide clues to cytological diversity within taxa for taxonomic and evolutionary considerations when species are counted again from new geographical areas (Stuessy, 1990). Inventory of the chromosome diversity has also provided very important cyto-floristic scopes of the regions. These approaches have been made especially on the oceanic islands including Canary Islands (Borgen, 1975, 1980), Hawaii Island (Carr, 1978, 1985), Juan Fernandez Islands (Sanders *et al.*, 1983; Spooner *et al.*, 1987; Sun *et al.*, 1990), Taiwan (Hsu, 1967, 1968), Ullung Island (Sun *et al.*, 1995), where unique ecological and geographical characteristics are. In addition, it is well known that polyploidy has played a very important role in the speciation of plants, especially angiosperms and ferns (Grant, 1981) and the polyploid complex can give a very decisive evolutionary directionality within the complex (Stuessy and Crisci, 1984). Therefore, inventory of the chromosome diversity is exclusively important as comparative data for systematics.

However, documents on the chromosome counts from Korean flora are very limited except for Lee's reports (Lee, 1967-1972), Sun *et al.* (1995) and sporadic reports in some monographic works. Therefore, the aim of this study is to understand the chromosome diversity from Korean flora emphasizing Apiaceae which shows relatively high species diversity and is economically important family.

MATERIALS AND METHODS

Materials were collected from various localities in Korea and all voucher specimens as shown in Appendix were kept in JNU.

For meiotic observation, flower buds were collected in the field, preserved in modified Carnoy's fixative (4 chloroform: 3 absolute ethanol: 1 glacial acetic acid), transferred to 70 % ethanol back in the laboratory, and stored under refrigeration. Slide preparations were made by squashing young florets and examining developing anthers in the pollen mother cells. For mitotic observation, fresh root tips were collected, treated with 0.05% colchichine solution, preserved in Carnoy's fixative (1 absolute ethanol: 3 acetic acid), and transferred to 70% ethanol. Slide preparations were made by squashing root tips after hydrolyzing with 1 absolute ethanol: 1 hydrochloric acid. Acetocarmine stain was used and preparations were made semipermanent with Hoyer's medium for both observations.

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RESULTS

Seventy-three new chromosome counts for seventy species from Korean flora including thirty-four counts for thirty-two species in Apiaceae are listed in Table 1. First counts are reported for 10 taxa: *Acanthopanax chiisanensis* (Aralicaeae), *Hydrocotyle japonica* (Apiaceae), *H. maritima* (Apiaceae), *Libanotis coreana* (Apiaceae), *Lindera sericea* (Lauraceae), *Quercus myrsinaefolia* (Fagaceae), *Rhamnus yoshinoi* (Rhamnaceae), *Salix hulteni* (Salicaceae), *Symplocos chinensis* for. *pilosa* (Symplocaceae) and *Vaccinium oldhami* (Ericaceae). Sixty-three additional counts are for taxa reported

Table 1. Chromosome counts of flowering plants from Korea emphasizing Apiaceae

Species Name	Chromosome number	
	sporophyte	gametophyte
Aceraceae 단풍나무과		
Acer ginnala Max. 신나무		13II
Aizoaceae 석류풀과		
Tetragonia tetragonoides O. Kuntze 번행초		16II
Apiaceae 산형화과		
Hydrocotyloideae 피막이풀아과		
Centella asiatica (L.) Urbain 병풀	18	
**Hydrocotyle japonica* Makino 제주피막이	ca. 96	
**H. maritima* Honda 선피막이		12II
Saniculoideae 참반디아과		
Sanicula chinensis Bunge 참반디	16	
Apioideae 미나리아과		
Angelica cartilagino-marginata (Mak. et Yabe) Nakai 처녀바디	22	
A. decursiva (Miq.) F. et S. 바디나물	22	
A. genuflexa Nutt. 왜천궁	22	11II
A. gigas Nakai 참당귀		
A. polymorpha Max. 궁궁이	22	
Anthriscus sylvestris Hoffm. 전호		8II
Bupleurum falcatum L. 시호	20	
B. longiradiatum Turcz. 개시호	12	
Cnidium japonicum Miq. 갯사상자		10II
C. officinale Makino 천궁	22	
***Cryptotaenia japonica* Hassk. 파드득나물	16	
	18	
Cymopterus crassus (Koidz.) Hiroe 큰참나물	22	
Cystaenia takeshimana (Nak.) Kitagawa 섬바디		22II
Foeniculum vulgare Gaertner 회향		11II
Heracleum moellendorffii Hance 어수리	22	11II
**Libanotis coreana* (Wolff) Kitagawa 털기름나물	22	
Oenanthe javanica (Bl.) DC. 미나리	42	
Osmorhiza aristata (Thunb.) Makino et Yabe 긴사상자	22	
Ostericum grosseserrata (Max.) Kitagawa 신감채	18	9II
O. sieboldii (Miq.) Nakai 묏미나리	22	
Peucedanum japonicum Thunb. 갯기름나물	22	
P. terebinthaceum Fisch. 기름나물	22	
Pimpinella brachycarpa (Kom.) Nakai 참나물		11II
P. gustavohegiana Koidz. 노루참나물	22	
P. koreana Nakai 가는참나물	22	
Pleurospermum camtschaticum Hoff. 누룩치	18	
Sium suave Walter 개발나물	12	
**S. ninsi L. 감자개발나물	18	
Araliaceae 오갈피나무과		
**Acanthopanax chiisanensis* Nakai 지리산오갈피		24II

*First report, **New chromosome level, All voucher specimens are listed in Appendix and kept in JNU.

Table 1. (Continued)

Species Name	Chromosome number	
	sporophyte	gametophyte
Asteraceae 국화과		
Carduus crispus L. 지느러미엉겅퀴		8II
Chrysanthemum boreale Makino 산국		9II
C. zawadskii Herbich. 산구절초		27II
Heteropappus hispidus Thunb. 갯쑥부쟁이		18II
Lactuca indica var. *laciniata* (O. Kuntze) Hara 왕고들빼기		9II
Solidago virga-aurea var. *asiatica* Nakai 미역취		9II
Youngia japonica (L.) DC. 뽀리뱅이		5II
Y. sonchifolia Max. 고들빼기		5II
Campanulaceae 초롱꽃과		
Adenophora triphylla var. *japonica* Hara 잔대		17II
Cannabinaceae 삼과		
Humulus japonicus S. et Z. 환삼덩굴		9II
Convolvulaceae 메꽃과		
Calystegia soldanella Roem. et Schult. 갯메꽃		11II
Ericaceae 진달래과		
**Vaccinium oldhami* Miq. 정금나무		12II
Fagaceae 참나무과		
**Quercus myrsinaefolia* Bl. 가시나무		12II
Q. serrata Thunb. 졸참나무		12II
Lamiaceae 꿀풀과		
Salvia chanroenica Nakai 참배암차즈기		8II
Lauraceae 녹나무과		
**Lindera sericea* (S. et Z.) Bl. 털조장나무		12II
Orchidaceae 난과		
Goodyera schlechtendaliana Reichb. fil. 사철란		15II
Papaveraceae 양귀비과		
Chelidonium majus var. *asiaticum* (Hara) Ohwi 애기똥풀		10II
Phytolaccaceae 자리공과		
Phytolacca esculenta V. Houtte 자리공		18II
P. insularis Nakai 섬자리공		36II
Phrymaceae 파리풀과		
Phryma leptostachya var. *asiatica* Hara 파리풀		14II
Plantaginaceae 질경이과		
Plantago camtschatica Cham. 개질경이		6II
Primulaceae 앵초과		
Androsace filiformis Retz. 애기봄맞이		9II
Ranunculaceae 미나리아재비과		
Clematis apiifolia A.P. DC. 사위질빵		8II
Ranunculus japonicus Thunb. 미나리아재비		7II
R. tachiroei Fr. et Sav. 개구리미나리	16	
Rhamnaceae 갈매나무과		
**Rhamnus yoshinoi* Makino 짝자래나무		12II
Rosaceae 장미과		
Agrimonia pilosa Ledeb. 짚신나물		28II
Rosa multiflora Thunb. 찔레		7II
Rubus crataegifolius Bunge 산딸기		7II
Rubiaceae 꼭두서니과		
***Asperula odorata* L. 선갈퀴		11II
Galium verum var. *asiaticum* Nakai 솔나물		22II
Salicaceae 버드나무과		
**Salix hulteni* Floderus 호랑버들		19II
Symplocaceae 노린재나무과		
**Symplocos chinensis* for. *pilosa* (Nakai) Ohwi 노린재나무		11II
Verbenaceae 마편초과		
Vitex rotundifolia L. fil. 순비기나무		17II

previsously, three of which, *Asperula odorata* (Rubiaceae), *Cryptotaenia japonica* (Apiaceae) and *Sium ninsi* (Apiaceae) are new numbers.

DISCUSSION

Discussions are provided on some of the counts reported here, alphabetically by family, with focus on first reports for species. General statements on numbers of speices counted within genera and their chromosomal data come from the standard chromosomal indices (Darlington and Wylie, 1955; Cave, 1958-1965; Ornduff, 1967-1969; Fedorov, 1969; Moore, 1970-1977; Goldblatt, 1981-1988; Goldblatt and Johnson, 1990-1994).

Apiaceae

Hydrocotyle L. with about 75 species mainly distributed in southern hemisphere (Mabberley, 1990), contains very diverse chromosome numbers from 2n =18 (*H. confera* Wight; Krishnappa & Basappa, 1988) to 2n=132 (*H. novae-zealaandica* var. *montane* Kirk; Webb & Beuzenberg, 1987). The genus as a whole is based on basic number, x=12. Our first counts of 2n=ca. 96 for *H. japonica* and 2n= 12 for *H. maritima* are consistent with the previous reports of the same genus. Hence, *H. maritima* is at diploid level and *H. japonica* is at octoploid level. Hiroe (1979) included *H. japonica* to *H. sibthorpioides* Lam. However, *H. sibthorpioides* has been consistently counted from 10 populations as 2n =24 except for two reports documenting two other levels as 2n=48 and 64 by Borgmann (1964). Therefore, it is more likely *H. japonica* is distinguished from *H. sibthorpioides* at least chromosomally.

Cryptotaenia DC. is a genus with about 5 species worldwide. *C. japonica* distributed in Korea, Japan and China, is sometimes treated as subspecies or variety or even same species of *C. canadensis* (L.) DC. in North America. However, Li (1952), Hara (1962) and Kitagawa (1979) suggested *C. japonica* is more likely to be considered as a separate species based on morphology of flower and inflorescence and distribution range of these two taxa.

The chromosome numbers of the genus have been counted as 2n=18, 20, and 22 for *C. japonica*, 2n= 20 and 22 for *C. canadensis*, and 2n=22 for *C. africana* Drude, as Hara (1962) pointed out aneuploid series may seem to exist in this group. Our counts from the populations of Ullung Island and Cheju Island show also aneuploid series within Korea as 2n =16 for Ullung Island population, which is new chromosome level and 2n=18 for Cheju Island population. Especially noteworthy is two different island populations show two different aneuploid levels.

Cymopterus crassus is a species, sometimes included in the genus *Ostericum* (Kitagawa, 1941; Lee, 1980), or *Halosciastrum* (Koidzumi, 1941). In recent monographs (Hiroe, 1979; Yoon, 1994), however, this species is included in the genus *Cymopterus* and the recombination name is published as *C. crassus* based on *Halosciastrum crassum* Koidzumi (Koidzumi, 1941) as basionym. [Here we follow the opinion of the most recent monograph of Yoon (1994)]. But the name is still problematic, because this species was first described by Boissieu (1903) as *Selinum melanotilingia*. On the other hand, Baroshilov (1982) gave another recombination name, *Halosciastrum melanotilgingia*, apparently based on the Boissieu's name. He also treated *Ligusticum purpureopetatum*, sometimes regarded as endemic species to Far East Russia, as same species. Gurzenkov and Gorovoy (1971) counted chromosome number of *H. melanotiligia* as 2n=22 and our count is exactly consistent with this report.

Libanotis Zinn. with about 15 species distributed in Eurasia (Sadake *et al.*, 1981). Only one species, *L. coreana* is confined to high ridge of Mt. Halla in Cheju island, Korea (Lee, 1980). Previous counts of this genus are consistently reported as 2n=22 except for one polyploid as 2n=44 for *L. siberia* (Rostovtseva, 1979). Our first count for *L. coreana* as 2n=22 is well accordance with previous reports.

Sium L. is a genus of 10 species distributed in Korea (2 species), China (3 species), Japan (3 species), and Europe (2 species)(Lee, 1980; Ohwi, 1984; Mabberley, 1990). *S. ninsi* L. (=*S. sisarum* L.) has been counted as 2n=20 (Schulz-Gaebel, 1930), 2n=22 (Bell and Constance, 1966), and 2n= 40 (Suzuka, 1953) from three populations. Our count of 2n=18 is new chromosome level for this species and only one count has been reported as 2n =18 for *S. erectum* Huds throughout the genus (Gadella and Kliphuis, 1973).

Araliaceae

Acanthopanax chiisanensis is endemic to Korea and related most closely to *A. divaricatus* (Sieb. et Zucc.) Seem. which distributes in Korea, China and Japan. Our first count of 2n=48 for *A. chiisanensis* and previous report of 2n=48 for *A. divaricatus*

coincide with counts for related taxa. Our count of 2n=48 places this species at tetraploid level within this genus.

Phytolaccaceae

Phytolacca L. with about 25 species mainly distributed in tropical and subtropical regions, has very diverse habits of herb, shrub and tree (Mabberley, 1990). In east Asia, three species, *P. esculanta, P. japonica* and *P. insularis*, and one introduced species, *P. americana* from North America are inhabited and all these have been counted chromosomally.

P. insularis, endemic to Ullung Island off the East Coast of Korean peninsula, shows 2n=72 as the same number of previous report by Lee (1972). In comparison of flower structure, Island endemic is assumed to be most closely related to *P. esculenta*, both of which have 8 connate carpels. However, *P. esculenta* has been known to be chromosomally as 2n=36 from our count here and previous reports of Chinese and Japanese populations(Oginuma and Tanaka, 1980). The Island endemic, thus, seems to be polyploid origin from the continent relative.

Rubiaceae

Asperulla odorata distributed in north of central Korea including Ullung Island, Japan, Saghalien, and Europe (Lee, 1980; Mabberley, 1990). Five chromosome counts for the European populations are reported consistently as tetraploid of 2n=44 (Tischler, 1934; Homeyer, 1935; Fagerlind, 1937; Skalinska *et al.*, 1959; Gadella and Kliphuis, 1972). However, our count from Ullung Island population show diploid of 2n=22 and this is new chromosome level for this species. To infer the origin of diploid in this young volcanic Island, cytological study from adjacent area would be much helpful.

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APPENDIX

List of voucher specimens of the chromosome counts in Table 1.

Aceraceae *Acer ginnala*, Sun *et al.*, Mt. Naebyun 149 (1990 Apr. 15); Sun *et al.*, Mt. Naebyun 327 (1991 Mar. 30).

Aizoaceae *Tetragonia tetragonoides*, Kim T.J. Huksan Is. (1990 May 13).

Apiaceae *Angelica cartilagino-marginata*, Sun *et al.*, Mt. Jucksang (1995 Sept. 5) *A. decursiva*, Sun *et al.*, Mt. Moak (1995 Sept. 1). *A. gigas*, Kim C.H., Mt. Chiri (1994 Sept. 1). *A. polymorpha*, Sun *et al.*, Mt. Chiri (1995 Aug. 29); Sun *et al.*, Mt. Jucksang (1995 Sept. 5). *A. genuflexa*, Sun *et al.*, Mt. Jucksang (1995 Sept. 5, 1995. Sept. 27). *Anthriscus sylvestris*, Sun *et al.*, Ullung Is. 1455 (1993 Apr. 17). *Bupleurum falcatum*, Kim C.H. Sunyu Is. (1995 Sept. 17). *B. longiradiatum*, Sun *et al.*, Mt. Odae (1995 July 8). *Centella asiatica*, Sun *et al.*, Cheju Anduk valley (1995 Sept. 16). *Cnidium japonicum*, Sun *et al.*, Dogdo Is. (1995 Aug. 14). *C. officinale*, Sun *et al.*, Ullung Is. (1995 Apr. 24). *Cryptotaenia japonica*, Sun *et al.*, Ul-

lung Is. (1995 Aug. 12). Sun *et al.*, Cehju *Torreya* forest conservation area (1995 Sept. 17). *Cymopterus crassus*, Sun *et al.*, Mt. Jucksang (1995 Sept. 5). *Dystaenia takeshimana*, Sun *et al.*, Ullung Is. 1150 (1991 June 6). *Foeniculum vulgare*, Sun *et al.*, Ullung Is. 3693 (1995 Aug. 13). *Heracleum moellendorffii*, Sun *et al.*, Mt. Duckyu (1994 Aug. 20). *Hydrocotyle japonica*, Sun *et al.*, Cheju Anduk valley (1995 Sept. 16). *H. maritima*, Sun *et al.*, Mt. Naebyun 200 (1990 Apr. 15). *Libanotis coreana*, Sun *et al.*, Mt. Halla (1995 Sept. 16). *Oenanthe javanica*, Sun, Chonju (1995 Sept. 28). *Osmorhiza aristata*, Sun *et al.*, Mt. Odae (1995 July 8). *Ostericum grosseserrata*, Sun *et al.*, Cheju Suak bridge (1995 Sept. 15). *O. sieboldii*, Sun *et al.*, Mt. Moak (1995 Sept. 1); Sun *et al.*, Mt. Jucksang (1995 Sept. 5). *Peucedanum japonicum*, Sun *et al.*, Uchung Is. (1995 May 27). *P. terebinthaceum*, Sun *et al.*, Mt. Odae (1995 July 8). *Pimpinella brachycarpa*, Kim C.H., Mt. Chiri (1994 Sept. 1). *P. gustavohegiana*, Sun *et al.*, Mt. Odae (1995 July 8). *P. koreana*, Sun *et al.*, Mt. Odae (1995 July 8); Sun *et al.*, Mt. Jucksang (1995 Sept. 5). *Pleurospermum camtschaticum*, Sun *et al.*, Mt. Chiri (1995 Aug. 29). *Sanicula chinensis*, Sun *et al.*, Ullung Is. 3800 (1995 Aug. 12); Sun *et al.*, Mt. Moak (1995. Sept. 1). *Sium suave*, Kim C.H., Mt. Chiri (1994 Sept. 1). *S. ninsi*, Sun *et al.*, Cheju 1100 m peak (1995 Sept. 18).

Araliaceae *Acanthopanax chiisanensis*, Sun and Kim C.H., Cheju 1100 m peak (1992 July 20).

Asteraceae *Carduus crispus*, Sun *et al.*, Mt. Naebyun 156 (1990 Apr. 15). *Chrysanthemum boreale*, Sun *et al.*, Mt. Naebyun 374 (1991 Mar. 30). *C. zawadskii*, Kim C.H., Mt. Chiri (1994 Sept. 1). *Heteropappus hispidus*, Sun *et al.*, Mt. Naebyun 373 (1991 Mar. 30). *Lactuca indica* var. *laciniata*, Sun *et al.*, Mt. Naebyun 122 (1990 Apr. 15). *Solidago virga-aurea* var. *asiatica*, Kim C.H., Mt. Chiri (1994 Sept. 1). *Youngia japonica*, Sun *et al.*, Mt. Naebyun 133 (1990 Apr. 15). *Y. sonchifolia*, Sun *et al.*, Chonju (1990 Apr. 7).

Campanulaceae *Adenophora triphylla* var. *japonica*, Sun *et al.*, Mt. Naebyun 365 (1991 Mar. 30).

Cannabinaceae *Humulus japonicus*, Sun *et al.*, Mt. Naebyun 115 (1990 Apr. 15).

Convolvulaceae *Calystegia soldanella*, Sun *et al.*, Mt. Naebyun 173 (1990 Apr. 15).

Ericaceae *Vaccinium oldhami*, Sun *et al.*, Mt. Naebyun 117 (1990 Apr. 15).

Fagaceae *Quercus myrsinaefolia*, Kim T.J., Hongdo Isl. (1990 May 12). *Q. serrata*, Sun *et al.*, Mt. Naebyun 306 (1991 Mar. 30).

Lamiaceae *Salvia chanroenica*, Sun *et al.*, Mt. Naebyun 342 (1991 Mar. 30).

Lauraceae *Lindera sericea*, Sun and Kim C.H., Mt. Moak (1994 Aug. 25).

Orchidaceae *Goodyera schlechtendaliana*, Sun *et al.*, Mt. Naebyun 179 (1990 Apr. 15).

Papaveraceae *Chelidonium majus* var. *asiaticum*, Sun *et al.*, Mt. Naebyun 215 (1990 Apr. 15).

Phytolaccaceae *Phytolacca esculenta*, Sun and Kim C.H., Cheju Anduk valley (1992 July 21). *P. insularis*, Sun *et al.*, Ullung Is. 3027 (1994 Apr. 28).

Phrymaceae *Phryma leptostachya* var. *asiatica*, Sun *et al.*, Mt. Naebyun 238 (1990 Apr. 15).

Plantaginaceae *Plantago camtschatica*, Kim T.J. Hucksan Is. (1990 May 13).

Primulaceae *Androsace filiformis*, Kim T.J. Iksan (?).

Ranunculaceae *Clematis apiifolia*, Sun *et al.*, Mt. Naebyun 228 (1990 Apr. 15). *Ranunculus japonicus*, Sun *et al.*, Mt. Unjang (?). *R. tachiroei*, Sun *et al.*, Ullung Is. (1995 Apr. 22).

Rhamnaceae *Rhamnus yoshinoi*, Sun *et al.*, Mt. Naebyun 310 (1991 Mar. 30).

Rosaceae *Agrimonia pilosa*, Sun *et al.*, Mt. Naebyun 210 (1990 Apr. 15). *Rosa multiflora*, Sun *et al.*, Mt. Naebyun 167 (1990 Apr. 15). *Rubus crataegifolius*, Sun *et al.*, Mt. Naebyun 117 (1990 Apr. 15).

Rubiaceae *Asperula odorata*, Sun *et al.*, Ullung Is. 3082 (1994 Apr. 29). *Galium verum* var. *asiaticum*, Sun *et al.*, Mt. Naebyun 352 (1991 Mar. 30).

Salicaceae *Salix hulteni*, Sun *et al.*, Mt. Unjang (1994 ?).

Symplocaceae *Symplocos chinensis* for. *pilosa*, Sun *et al.*, Mt. Unjang (1994 ?).

Verbenaceae *Vitex rotundifolia*, Sun and Kim C.H. Cheju Is. (1992 July 22).

한국산 피자식물의 염색체 수 -산형과를 중심으로-

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적 요

산형과 32종 34개 집단을 포함하는 한국산 피자식물 70종 73개 집단의 감수분열 및 체세포분열상을 관찰하여 염색체 수를 조사하였다. 이 중 염색체의 수가 처음으로 보고되는 종은 지리산오갈피(*Acanthopanax chiisanensis*; 2n=48), 제주피막이(*Hydrocotyle japonica*; 2n=ca. 96), 선피막이(*H. maritima*; n=12), 털기름나물(*Libanotis coreana*; 2n=22), 털조장나무(*Lindera sericea*; n=12), 가시나무(*Quercus myrsinaefolia*; n=12), 짝자래나무(*Rhamnus yoshinoi*; n=12), 호랑버들(*Salix hulteni*; n=19), 노린재나무(*Symplocos chinensis* for. *pilosa*; n=11) 그리고 정금나무(*Vaccinium oldhami*; n=12) 등 10종류이었으며 기존의 보고와 다른 새로운 수가 밝혀진 종류는 선갈퀴(*Asperula odorata*; n=11), 파드득나물(*Cryptotaenia japonica*; 2n=16) 그리고 감자개발나물(*Sium ninsi*; 2n=18) 등 3종류 이었다. 아울러 이들이 나타내는 분류학적 특성들을 논의하였다.

주요어: 염색체 수, 한국식물, 산형과

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