

Taxonomic Studies on the Tribe Senecioneae of Eastern Asia

II. Enumeration of the Species of Eastern Asia

(Continued from this Memoir, Vol. II. No. 1, p. 60)

by

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Genus **Senecio**

Senecio is an immense genus comprising probably over 1,500 species, and of very wide geographic distribution. The great amount of variability found in some taxonomic characters and the extremely different habitats occupied by some species of the genus have led to recognise a number of species. Further studies, therefore, should be made from the standpoints of both morphology and ecology.

The delimitation of this genus has been given in various ways by the authors. Some taxonomists have considered that *Senecio* includes such genera as *Ligularia*, *Cacalia* and others. On the other hand, some have recognized the genus *Senecio* without these satellite genera. As mentioned in the previous pages, these satellite genera may better be treated as distinct genera. *Senecio* should be restricted to some close and direct allies of the type species '*S. vulgaris*'.

Senecio L. Gen. Pl. ed. V : 373 (1754) Type : *S. vulgaris*; KITAM. Comp. Jap. III : 229 (1942); HARA, Enum. Sperm. Jap. II : 253 (1952) incl. syn.; SCHISCHK. Fl. URSS, XXVI : 699 (1961); OHWI, Fl. Jap. Eng. ed. 885 (1965).

Annual, biennial or perennial herbs, undershrubs or shrubs. Leaves alternate, radical or caudine, entire or variously divided. Inflorescences solitary, corymbose or racemose, heterogamous. Heads discoid or radiate, with or without bracteoles. Ray florets female, ligulate, usually yellow or reddish yellow. Disk florets hermaphrodite, fertile, tubular, 5-lobed at apex. Anther bases obtuse or tailed; tails contiguous or connate. All cells of upper part of fila-

ment same in size or the lower cells larger than the upper cells. Style branches of disk florets truncate or penicillate with hair at tips. Achenes glabrous or pubescent with white or tawny, bristle pappus.

More than 40 sections have been credited to *Senecio*, but only six of them occur in our region. They are divided by the following characters.

- A. Peduncles bractless except bracteate in *S. takedamus*; cells of upper part of filament same in size. B.
- A. Peduncles bracteate; cells of upper part of filament different in size. ... C.
- B. Narrow tube of corolla 3-4 times as long as the rest part. Sect. **Nemosenecio**.
- B. Narrow tube of corolla 1-1.5 times as long as the rest part. Sect. **Tephroseris**.
- C. Ray florets epappose. Sect. **Madaractis**.
- C. Ray florets pappose. D.
- D. Anther cell tailed at bases. Sect. **Synotis**.
- D. Anther cell obtuse at bases, not produced downwards into tail. E.
- E. Heads small or medium in size, large in number. Sect. **Jacobaea**.
- E. Heads large in size, small in number. Sect. **Crociseris**.
Sect. **Nemosenecio** KITAM. in Acta Phytotax. Geobot. 6 : 266 (1937), Comp. Jap. III : 230 (1942); KOYAMA in Acta Phytotax. Geobot. 22 : 15 (1966).

Heads without bracteoles. Narrow tube of corolla 3-4 times as long as the rest part. Anther base obtuse or subauriculed. Cells of upper part of filament same in size. All florets pappose.

- A. Involucral scales 6-8 in number. **S. solenoides**.
- A. Involucral scales more than 10 in number. B.
- B. Heads large, involucres 5 mm in length, pappus 6-7 mm in length. **S. nikoensis**.
- B. Heads small, involucres 3 mm in length, pappus 5 mm in length. **S. formosanus**.

Senecio solenoides DUNN in Journ. Linn. Soc. 35 : 508 (1903) Type : China, Prov. Yunnan : Mi-Le Distr., A. Henry 9678 A (Isoparatype in TNS).

CHINA Prov. Yunnan : Mi-Le distr., A. Henry 9678 A (TNS).

The specimen deposited in our herbarium is an imperfect specimen without head. Microscopical observation is not yet made as to the cells of upper part of filament. By the specimen cited above and the original description, the present species may better be referred to this section.

Senecio nikoensis MIQ. in Ann. Mus. Bot. Lugd.-Bat. 2 : 182 (1866) Type from Nikko in Honshu; KITAM. Comp. Jap. III : 230 (1942); HARA, Enum. Sperm. Jap. II : 256 (1952); OHWI, Fl. Jap. Eng. ed. 886 (1965); KOYAMA in Acta Phytotax. Geobot. 21 : 132 (1965), l. c. 22 : 15 (1966).

Endemic to Japan; on moist slope in mountain forest.

Chromosome number : $n=24$, $2n=48$ (KOYAMA a).

The previous reports by ISHIKAWA (1916) and ARANO (1962, '65), $n=10$ and $2n=40$ chromosomes, are erroneous.

Senecio formosanus KITAM. in Acta Phytotax. Geobot. 3 : 140 (1934), Comp. Jap. III : 231 (1942) Type : Taiwan, Prov. Takao : Kanzangoe, K. Ko-

Fig. 1. Range of *Senecio nikoensis*.

jima (Holotype in KYO).

Senecio nikoensis var. *formosanus* SASAKI in Trans. Taiwan Nat. Hist. Soc. 19: 221 (1929) Type : Taiwan, Prov. Karenko : Mt. Noko, *E. Matuda* (Holotype in TI).

Endemic to Taiwan ; on rather wet slope in mountainous regions.

Sect. **Tephroseris** REICHB. Fl. Germ. Ecx. 241 (1831) ; KITAM. Comp. Jap. III : 233 (1942) incl. syn. ; SCHISCHK. Fl. URSS, XXVI: 753 (1961).

Most of the species of this section occur in Eurasia and some are introduced into North America.

The present section has a close affinity to Sect. *Nemosenecio*. The radical leaves are persistent in flowering season among the members of this section, but they are extinct in Sect. *Nemosenecio*.

Chromosome counts are made as to the following species.

Species	n	2n	Investigator
<i>Senecio flammeus</i>		46	ARANO 1962.
		48	KOYAMA 1966 c.
<i>Senecio furusei</i>		48	"
<i>Senecio integrifolius</i>	24		OKABE 1931.
		46	S. & S. 1938 in DAR. & WY. 1955.
		48	S. & S. 1941 in DAR. & WY. 1955 ; RUTLAND 1941 ; KOYAMA not yet published.
		90	S. & S. 1941 in DAR. & WY. 1955.
<i>Senecio pierotii</i>		48	ARANO 1962 ; KOYAMA not yet published.
<i>Senecio alpestris</i>	23, 25		AFZELIUS 1924.
<i>Senecio atripurpureus</i>		ca. 48	S. & S. 1960 in CAVE 1961.
<i>Senecio cladobotrys</i>		24	S. & S. 1940 in DAR. & WY. 1955.
<i>Senecio spathulifolius</i>	24, 25		AFZELIUS 1949.
<i>Senecio jacuticus</i>		ca. 48	S. & S. 1960 in CAVE 1961.

Key to the species

- A. Leaves ovate, cordate at base, long petioled. B.
- A. Leaves lanceolate, cuneate or truncate at base, shortly petioled. C.
- B. Involucres 7 mm long ; ligulate corollas 10 mm long. *S. koreanus*.
- B. Involucres 3 mm long ; ligulate corollas 6 mm long. *S. oldamianus*.
- C. Ligulate corollas orange-red except yellow in *S. furusei* ; involucres dark purplish. D.
- C. Ligulate corollas yellow ; involucres green. G.
- D. Peduncles bracteate ; ligulate corollas short, less than 10 mm long. *S. takedanus*.
- D. Peduncles bractless ; ligulate corollas 16 - 22 mm long. E.
- E. Achenes glabrous or slightly hairy ; ligulate corollas 16 - 18 mm long, 2 - 2.5 mm wide ; receptacles without small holes. *S. aurantiacus*.
- E. Achenes densely hairy ; ligulate corollas 17 - 22 mm long, 2 mm wide ; receptacles with small holes. F.
- F. Ligulate corollas orange-red. *S. flammeus*.
- F. Ligulate corollas yellow. *S. furusei*.

- G. Radical leaves truncate at base, long petioled. H.
- G. Radical leaves narrowed to an indistinct petiole. I.
- H. Radical leaves ovate; achenes hairy. *S. birubonensis*.
- H. Radical leaves oblanceolate; achenes glabrous. *S. kawakamii*.
- I. Involucres 4 - 5 mm long. *S. pseudosonchus*.
- I. Involucres 6 - 8 mm long. J.
- J. Achenes hairy; radical leaves small, 5 - 10 cm long. *S. integrifolius*.
- J. Achenes glabrous; radical leaves large, 10 - 25 cm long. K.
- K. Stems and leaves glabrous. *S. taitoensis*.
- K. Stems and leaves hairy. *S. pierotii*.

Senecio koreanus KOMAROV in Act. Hort. Petrop. 18: 421 (1900) Type from Prov. Keng-son in Korea; KITAM. Comp. Jap. III: 234 (1942).

Endemic to northern Korea.

Senecio oldamianus MAXIM. in Bull. l'Acad. Pétersb. 16: 219 (1871) Type from China.

CHINA. Prov. Kiangsi: Lushan, *T. S. Ryu* (KYO). Prov. Anhwei: Hsi, *H. Migo* 210 (KYO). Prov. Chekiang: Mt. Pei-shan, *H. Migo* 209 (KYO), Ningpo, *C. W. Everard* (KYO), Hangchou, collector unknown TNS 7680 (TNS).

Senecio takedanus KITAM. in Acta Phytotax. Geobot. 2: 47 (1933), Comp. Jap. III: 235 (1942); HARA, Enum. Sperm. Jap. II: 258 (1952); OHWI, Fl. Jap. Eng. ed. 886 (1965). — *Senecio flammeus* var. *alpina* TAKEDA in Bot. Mag. Tokyo, 24: 67 (1910) Type from Mt. Yatsugatake in Honshu.

Endemic to Honshu; on open slope of alpine regions.

Senecio aurantiacus DC. Prod. VI: 361 (1837) Type from Europe.

The present species distributes widely in the temperate zone in Eurasia, and are represented by various forms in several regions.

Var. *leiocarpus* BOISS. Fl. Orient. III: 412 (1875) Type from China; KITAM. Comp. Jap. III: 237 (1942) incl. syn.

This variety occurs in Northeast Asia and differs from var. *aurantiacus* in having the achenes being glabrous or sparsely hairy.

Senecio flammeus TURCZ. ex DC. Prod. VI: 362 (1837) Type from Nezinskoiavod in Dahuria; KITAM. Comp. Jap. III: 236 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II: 254 (1952); OHWI, Fl. Jap. Eng. ed. 886 (1965).

Two subspecies are arranged by KITAMURA. Subsp. *flammeus* differs from subsp. *glabrifolius* in having brownish curled hairs on stem and leaf beneath in addition to arachnoid hairs.

Subsp. *flammeus*

Distribution: northern China, Manshuria, Dahuria, Korea and Kyushu; on sunny slope in mountainous areas.

Subsp. *glabrifolius* (CUF.) KITAM. in Acta Phytotax. Geobot. 6: 269 (1937), Comp. Jap. III: 236 (1942). — *Senecio flammeus* var. *glabrifolius* CUF. in FEDDE Rep. Sp. Nov. Beiheft, 70: 90 (1933) Type: Honshu: Karuisawa, *U. Faurie* 6007 (Isotype in KYO); HARA, Enum. Sperm. Jap. II: 254 (1952); OHWI, Fl. Jap. Eng. ed. 886 (1965).

Distribution : Korea and Honshu ; on grassy slope in mountainous areas.

Senecio furusei KITAM. in Acta Phytotax. Geobot. 14 : 147 (1952) Type : Honshu, Pref. Saitama : Mt. Futago, *M. Furuse* (Holotype in KYO).

HONSHU Pref. Gumma : Mt. Kanai, Nakazato-mura, *T. Satomi* (TNS); ibid., *M. Tobe* (TNS). Pref. Saitama : Mt. Futago, *M. Furuse* 13180 (KYO), 13181 (TI), TNS 147827 (TNS); ibidem, *M. Ikuse & E. Ito* (TNS); ibidem, *T. Moriya* (TNS); ibidem., *H. Koyama* 1960—2n=48 (KYO).

Endemic to Honshu ; restricted to limestone area.

Senecio birubonensis KITAM. in Acta Phytotax. Geobot. 6 : 270 (1937), Comp. Jap. III : 238 (1942) incl. syn. Type: Korea, Prov. Kogen : Mt. Kongo, *S. Kitamura* (Holotype in KYO).

Endemic to Korea ; on rocky slope of high mountain.

Senecio kawakamii MAKINO in Bot. Mag. Tokyo, 26 : 291 (1912) Type : Hokkaido, Prov. Kitami : Mt. Rishiri Island, *T. Makino* (Lectotype in TI); KITAM. Comp. Jap. III : 239 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II : 255 (1952) incl. syn.; OHWI, Fl. Jap. Eng. ed. 886 (1965).

Distribution : Saghalin, Kuriles and Hokkaido ; on moist grassy slope.

Senecio pseudo-sonchus VANT. in Bull. l'Acad. Géogr. Bot. 11 : 349 (1902) Type from Kuichau in China ; KITAM. Comp. Jap. III : 243 (1942) incl. syn.

Distribution : China, Manshuria and Korea.

Senecio integrifolius (L.) CLAIR. Man. d'herbor. 241 (1811); KITAM. Comp. Jap. III : 240 (1942); HARA, Enum. Sperm. Jap. II : 254 (1952) incl. syn. — *Othonna integrifolia* L. Sp. Pl. II : 925 (1753) Type from Europe.

This widely distributed species has various forms ; two subspecies are arranged by KITAMURA.

Subsp. *integritfolius*

This subspecies distributes widely in Europe and Asia, but does not invade in Japan.

Subsp. *fauriei* (LÉV. et VANT.) KITAM. in Acta Phytotax. Geobot. 6 : 272 (1937), 1. c. 9 : 37 (1940), Comp. Jap. III : 240 (1942) incl. syn. — *Senecio fauriei* LÉV. et VANT. in FEDDE Rep. Sp. Nov. 8 : 139 (1910) Type : Korea, Prov. Kogen : Mt. Kongo, *U. Faurie* 1097 (Isotype in KYO), non FRANCH. (1892).

Senecio integrifolius var. *spathulatus* (MIQ.) HARA, Enum. Sperm. Jap. II : 254 (1952); OHWI, Fl. Jap. Eng. ed. 887 (1965). — *Senecio aurantiacus* MIQ. in Ann. Mus. Bot. Lugd.-Bat. 2 : 181 (1866) incl. vars. *spathulata*, *elatior* et *foliosa* MIQ. Type from Japan.

Distribution : Honshu, Shikoku, Kyushu, Korea, Manshuria, China and Taiwan ; on sunny grassy slope in mountain.

The present subspecies is characterized by having oblong leaves which are gradually narrowed at the base.

Senecio taitoensis HAYATA, Mater. Fl. Formos. 156 (1911) Type : Taiwan, Prov. Karenko : between Shinjo and Batakan, *B. Hayata* (Holotype in TI); KITAM. Comp. Jap. III : 243 (1942).

Endemic to Taiwan ; on the sea side of eastern Taiwan.

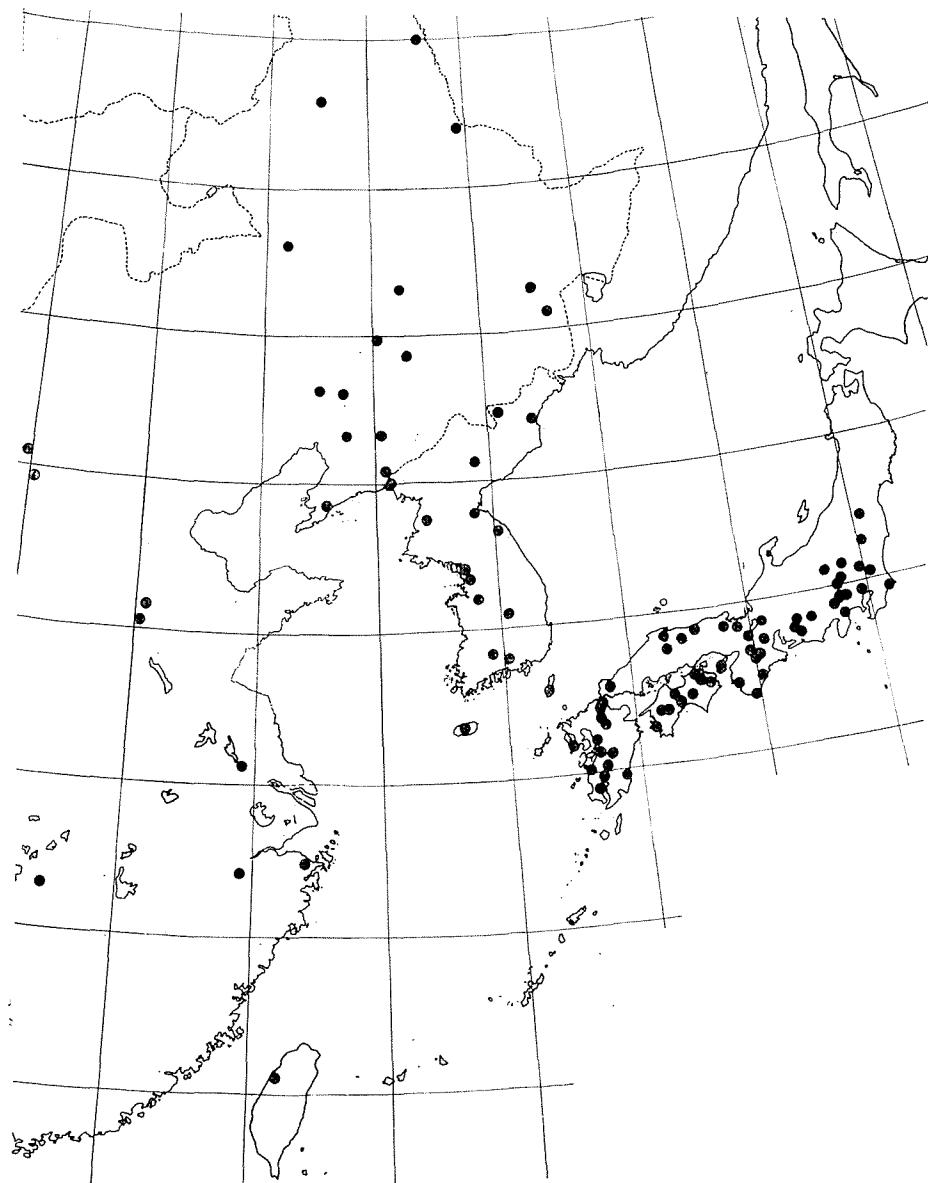


Fig. 2. Ranges of *Senecio integrifolius* subsp. *fauriei*.

Senecio pierotii MIQ. in Ann. Mus. Bot. Lugd.-Bat. 2 : 182 (1866) Type from Fodoroki in Kyushu; KITAM. Comp. Jap. III : 242 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II : 256 (1952); OHWI, Fl. Jap. Eng. ed. 887 (1965).

Distribution: Honshu, Shikoku, Kyushu and Ryukyu; on moist grassy slope.

Sect. **Madaractis** (DC.) HOOK. f. Fl. Brit. Ind. III : 343 (1881); HOFFM. in ENGLER u. PR. Pfl.-fam. IV-5: 298 (1892). — *Madaractis* DC. Prod. VI : 439 (1837) Type: *S. pinnatifidus*.

Heads bracteolate. Narrow tube of corolla as long as the rest part. The lower cells of upper part of filament are larger than the upper cells. Anther bases subauricled. Ray florets epappose. Pappus shorter than achenes.

Less than 20 species are known; most of them occur in central India and Ceylon, and the following two species distribute in Himalayas. None of the chromosomal accounts for these species have yet been given.

- A. Lower leaves scarcely auriculate. *S. linifolius*.
- A. Lower leaves auriculate. *S. saxatilis*.

Senecio linifolius (DC.) CLARKE, Comp. Ind. 202 (1876); HOOK. f. Fl. Brit. Ind. III : 343 (1881). — *Doronicum linifolium* DC. Prod. VI : 322 (1837) Type from eastern India.

ASSAM Khasia hills, *J. D. Hooker & T. Thomson* (TNS).

Endemic to eastern Himarayas; on rocky banks of streams, 4,000 - 7,000 ft. alt.

Senecio saxatilis WALL. ex DC. Prod. VI : 367 (1837) Type from Taong-Dong in eastern India; HOOK. f. Fl. Brit. Ind. III : 344 (1881).

ASSAM Khasia hills: near Shillong, *H. Kihara & S. Nakao* (KYO).

The following species was described by CLARKE from upper Assam and accepted by HOOKER f., though further study will be requested as to the discrimination of the species.

Senecio mishmi CLARKE, Comp. Ind. 203 (1876) Type from Mishmi hills in upper Assam; HOOK. f. Fl. Brit. Ind. III : 344 (1881).

Sect. **Synotis** BENTH. in BENTH. et HOOK. f. Gen. Pl. II : 448 (1873); KITAM. Comp. Jap. III : 232 (1942).

Peduncles bracteolate. Narrow tube of corolla as long as the rest part. The lower cells of upper part of filament are larger than the upper cells. Anther bases tailed.

About 20 species are known and mostly occur in southeastern Asia as well as India, Himalayas and Japan. Only one species is cytologically examined. They may better be arranged in three series as follows:

- A. Climbing leafy shrubs or undershrubs. Series **Scandentes**.
- A. Not climbing. B.
- B. Herbs or undershrubs with radical or subradical leaves. Series **Synotis**.
- B. Erect herbs with leafy stems. Series **Erectae**.

Series **Scandentes** (CLARKE) H. KOYAMA stat. nov. — Sect. *Scandentes* CLARKE, Comp. Ind. 177 (1876).

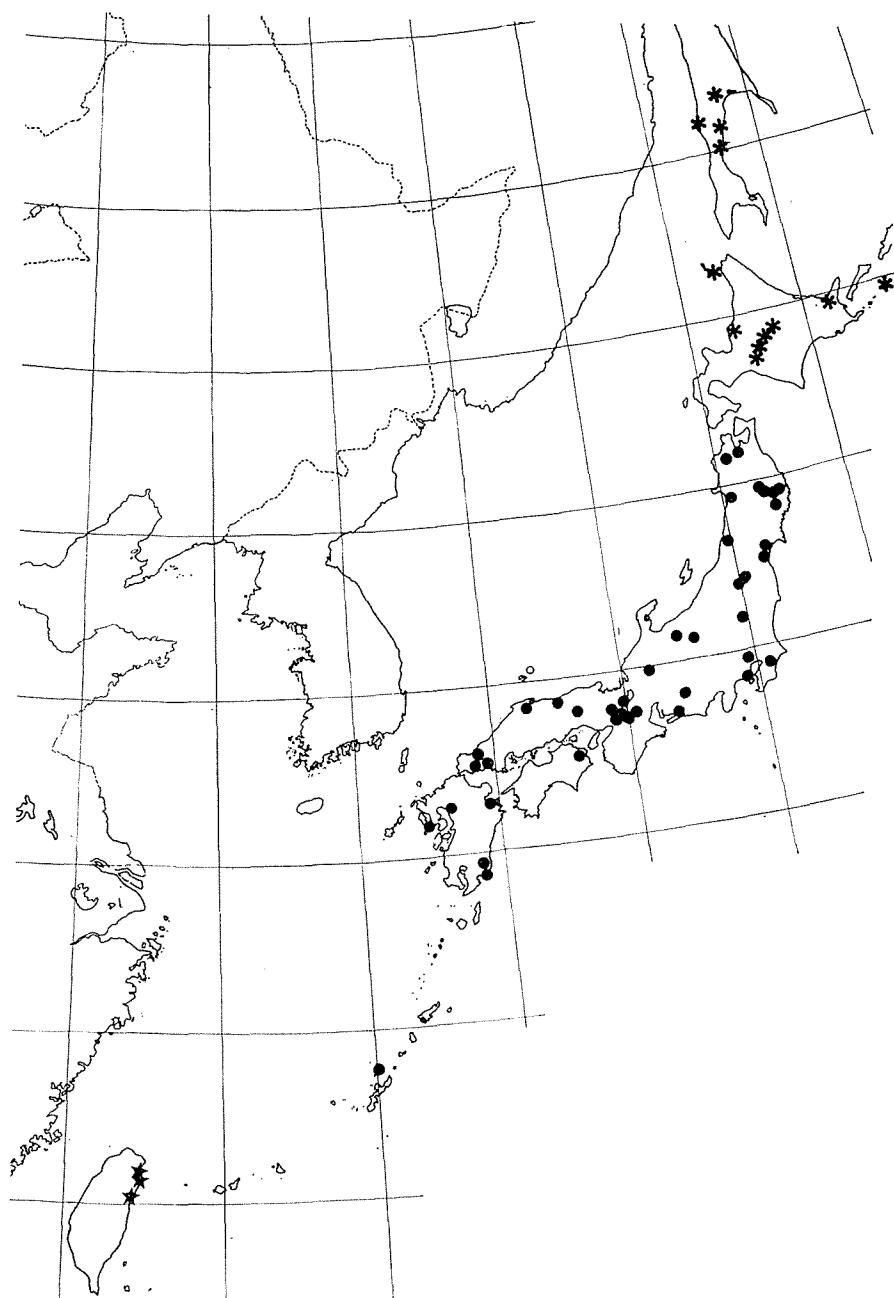


Fig. 3. Ranges of *Senecio kawakamii* (*), *S. pierotii* (●) and *S. taitoensis* (★).

- A. Leaves ovate-hastate ; involucral scales 10 - 12 in a head. *S. scandens*
- A. Leaves ovate-cordate ; involucral scales 8 in a head. *B.*
- B. Heads radiate. *S. buimalia*.
- B. Heads discoid. *S. araneosus*.

Senecio scandens BUCH.-HAM. ex D. DON, Prod. Fl. Nepal. 178 (1825)
 Type from Nepal ; KITAM. Comp. Jap. III : 232 (1942) incl. syn., in KIHARA
 Fau. Fl. Nepal Himal. I : 271 (1955); HARA, Enum. Sperm. Jap. II : 257 (1952)
 incl. syn.; OHWI, Fl. Jap. Eng. ed. 885 (1965).

Three varieties are recognized in this species.

Var. **scandens**

Distribution : Himalayas, Indo-China, Philippines, southern China, Taiwan, Shikoku and southern Honshu ; on rather dry slope near beach in Japan, but in mountainous areas in further south regions.

Chromosome number : $n = 10$ (CHUANG et al. 1963). $2n = 20$ (ARANO 1962; KOYAMA not yet published.).

Var. **crataegifolius** (HAYATA) KITAM. in Acta Phytotax. Geobot. 9 : 37 (1940), Comp. Jap. III : 233 (1942). — *Senecio crataegifolius* HAYATA, Icon. Pl. Formos. VIII : 67 (1919) Type : Taiwan, Prov. Taito : in montibus centralibus, *T. Kawakami & U. Mori* (Holotype in TI).

Endemic to Taiwan ; on moist slope at the middle elevation of mountain.

Var. **incisa** FRANCH. in MOROT, Journ. Bot. 10 : 418 (1896) Type from Prov. Szechuan, China.

Chromosome number : $n = 10$ (AFZELIUS 1924).

TAIWAN Prov. Taihoku : between Mt. Chung-yang-Chien and Nan-shan along Hagapalis river, *M. Tamura & H. Koyama* 23706 (KYO).

Habitat : on grassy slope at higher elevation, 2400 m alt.

This is the first record of this variety in Taiwan.

Senecio buimalia BUCH.-HAM. ex D. DON, Prod. Fl. Nepal. 178 (1825)

Type from Nepal ; HOOK. f. Fl. Brit. Ind. III : 352 (1881); KITAM. in HARA Fl. East. Himal. 343 (1966).

E-NEPAL Yektin - Akasay, *H. Hara et al.* 6306345 (TI; KYO); Mul Pokhari - Dumhan, *H. Hara et al.* 6306346, 6306347 (TI; KYO).

Distribution : Nepal and Sikkim.

Senecio araneosus DC. Prod. VI : 364 (1837) Type from Prov. Silhet in India; HOOK f. Fl. Brit. Ind. III : 351 (1881).

CHINA Prov. Yunnan : Mengtze, *A. Henry* 9178 B, C (TNS).

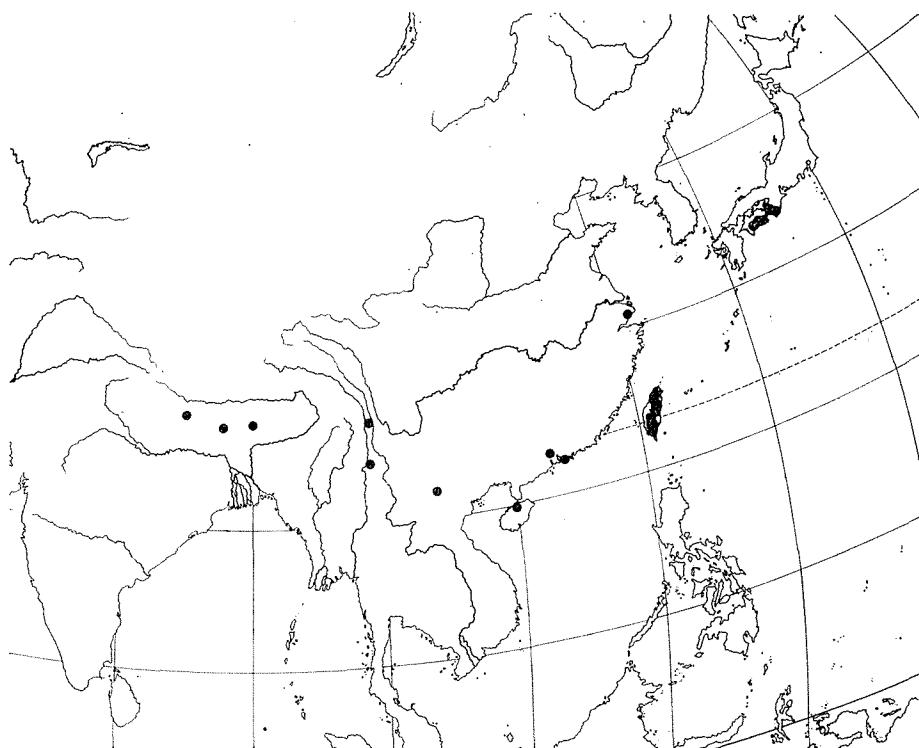
The following species may be referred to this series.

Senecio corymbosus WALL. ex DC. Prod. VI : 364 (1837) Type from Mt. Neelgherry in India.

Senecio hoi DUNN in Journ. Linn. Soc. Bot. 35 : 506 (1903) Type from Prov. Yunnan, China.

Senecio yalungensis HAND.-MZT. in Sitzgsanz. Ak. W. W. 62 : 148 (1925)
 Type from Prov. Szechuan, China.

Series **Synotis**. — Sect. *Semiscandentes* CLARKE, Comp. Ind. 177 (1876).

Fig. 4. Range of *Senecio scandens*.

- A. Involucres 3 mm in length ; leaves long petioled, wingless. *S. tetranthus*.
 A. Involucres more than 5 mm in length. B.
 B. Leaves radical, wingless ; inflorescences thyrsoid-corymbose. ... *S. wallichii*.
 B. Leaves subradical or cauline, winged ; inflorescences large, much branched, thyrsoid-panicle. *S. alatus*.

Senecio tetranthus DC. Prod. VI : 370 (1838) Type from Nepal ; KITAM. in HARA Fl. East. Himal. 344 (1966).

E-NEPAL Selap - Walunchung Gola, *H. Kanai*, *G. Murata* & *M. Togashi* 6306377 (TI; KYO); Diorali Bhanjang - Bhandukay, *H. Hara*, *S. Kurosawa* & *T. Tuyama* 6306376 (TI; KYO); Thakma Khola - Yamphoodin, *H. Kanai*, *G. Murata* & *M. Togashi* 6306375(TI); Minchin Dhap - Mul Pokhari, *H. Hara et al.* 6306378 (TI; KYO); Hati Sar - Minchin Dhap, *H. Hara et al.* 6306379 (TI); Bilbatay Bhanjang - Hati Sar, *H. Hara et al.* 6306380 (TI; KYO; TNS). E-HIMALAYA Seucbal, *K. Biswas* 5918 (KYO).

Distribution : Nepal and Sikkim.

Senecio wallichii DC. Prod. VI : 364 (1837) Type from Gossain-Than in

Nepal ; Hook. f. Fl. Brit. Ind. III : 352 (1881) ; KITAM. in HARA Fl. East. Himal. 344 (1966).

E-NEPAL Hati Sar - Minchin Dhap, *H. Hara et al.* 6306384 (TI) ; at the summit of Tute, *H. Hara* (TI). SIKKIM Native collector (TI). BHUTAN Between Sunje Thong and Bonsum, *S. Nakao* 337 (KYO).

Distribution : Nepal, Sikkim and Bhutan ; 2800 m alt.

Florets 5 in a head, three of them hermaphrodite and the rest female, but not ligulated.

Senecio alatus WALL. ex DC. Prod. VI : 368 (1837) Type from Gossain-Than in Nepal ; Hook. f. Fl. Brit. Ind. III : 352 (1881) ; KITAM. in HARA Fl. East. Himal. 343 (1966).

E-NEPAL Between Amjiresa and Yangzho, *K. Nishioka* 977, 1024 (KYO) ; between Nango La and Wallung Chung Gola, *K. Nishioka* 1129 (KYO) ; Birwa - Yektin, *H. Kanai*, *G. Murata* & *M. Togashi* 6306334 (TI ; KYO ; TNS) ; Baroya Khimty, *H. Hara*, *S. Kurosawa* & *T. Tuyama* 6306335, 6306339 (TI ; KYO) ; Batasay - Bhuspate Danra, *H. Hara et al.* 6306336 (TI ; KYO ; TNS) ; Thakma Khola - Yamphodin, *H. Kanai*, *G. Murata* & *M. Togashi* 6306337 (TI ; KYO) ; Baroya Khimty - Thakma Khola, *H. Kanai*, *G. Murata* & *M. Togashi* 6306338 (TI ; KYO) ; Iladanda - Selap, *H. Kanai*, *G. Murata* & *M. Togashi* 6306340 (TI ; KYO) ; above Lelep, *T. Tuyama* 6306341 (TI ; KYO) ; Minchin Dhap - Mul Pokhari, *H. Hara et al.* 6306342 (TI ; KYO) ; Mangalbare, *H. Hara et al.* 6306343 (TI) ; Tinjuray, *H. Hara et al.* 6306344 (TI ; KYO) ; Zongi - Iladanda, *H. Kanai*, *G. Murata* & *M. Togashi* (TI). E-INDIA Darjeeling : Rimbick - Raman, *H. Kanai et al.* 5612 (TI).

Distribution : Nepal, northeastern India and Sikkim ; 2600 - 3800 m alt.

Following Chinese species may be referred to this series.

Senecio fulvipes LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5 : 27 (1937) Type from Prov. Hunan.

Series **Erectae** (CLARKE) H. KOYAMA stat. nov. — Sect. *Erectae* CLARKE, Comp. Ind. 177 (1876).

Key to the species

- A. Leaves glabrous on both surfaces. B.
- A. Leaves cottony beneath ; involucral scales and ligules more than five. ... C.
- B. Involucral scales 3-5, ligule solitary and minute. *S. acuminatus*.
- B. Involucral scales 8, ligules 3-4. *S. trigulatus*.
- C. Heads peduncled. D.
- C. Heads subsessile ; inflorescences terminal or axillary, rounded corymbose. ... E.
- D. Inflorescences terminal and panicle. *S. nagensium*.
- D. Inflorescences broad terminal corymbose. *S. kunthianus*.
- E. Ligules 8 - 10 in a head. *S. densiflorus*.
- E. Ligules 4 - 5 in a head. *S. rufinervis*.

Senecio acuminatus WALL. ex DC. Prod. VI : 368 (1837) Type from Nepal ; Hook. f. Fl. Brit. Ind. III : 354 (1881) ; KITAM. in KIHARA Fau. Fl. NepalHimal. I : 270 (1955), in HARA Fl. East. Himal. 343 (1966).

NEPAL Tolo Gompa Khola, *S. Nakao* (KYO; TNS); Dorzhong, *S. Nakao* (KYO; TI); between Amjiresa and Yangzho, *K. Nishioka* 1025 (KYO). E-NEPAL Hati Sar - Minchin Dhaph, *H. Hara et al.* 6306333 (TI; KYO); Batasay - Bhuspate Danra, *H. Hara et al.* 6306332 (TI; KYO); Bilbatay Bhanjang - Hati Sar, *H. Hara et al.* (TI); Thakma Khola - Yamphodin, *H. Kanai*, *G. Murata* & *M. Togashi* (TI); above Lelep, *T. Tuyama* (TI). E-INDIA Darjeeling; Caribans - Tanglu, *H. Hara et al.* 5639 (TI). BHUTAN Dorsho, *S. Nakao* 511 (KYO). CHINA Prov. Yunnan: Mts. SW of Megtze, *A. Henry* 9086 A (TNS).

Distribution: Nepal, Bhutan and Yunnan; 2500 - 2900 m alt.

Nakao 511 is noted as 1.3 m in height.

Senecio triligulatus HAMILT. ex D. DON, Prod. Fl. Nepal. 178 (1825) Type from Nepal; HOOK. f. Fl. Brit. Ind. III: 356 (1881); KITAM. in HARA Fl. East. Himal. 344 (1966).

E-NEPAL Birwa - Yektin, *H. Kanai*, *G. Murata* & *M. Togashi* 6306381 (TI; KYO; TNS); Bilbatay Bhanjang, *H. Hara et al.* 6306382 (TI; KYO). NEPAL Kenza, *K. Yoda* (KYO); Katakote, *K. Yoda* (KYO). CHINA Prov. Yunnan: Mts. SW of Megtze, 6000 foot alt., *A. Henry* 9086 A (TNS).

Distribution: Nepal, Mishmi, upper Burma, northern Thailand and southern China.

Senecio nagensium CLARKE in Journ. Linn. Soc. Bot. 25: 39 (1889) Type from Burma.

Two varieties are acceptable.

Var. **nagensium**

Leaves are said to have wooly hairs beneath and without reddish hair on nerves. No specimen has been examined by me.

Var. **lobbii** (HOOK. f.) CRAIB in Kew Bull. 1911: 402 (1911); KERR, Fl. Siam. Enum. III: 291 (1936) incl. syn. — *Senecio densiflorus* var. *lobbii* HOOK. f. Fl. Brit. Ind. III: 355 (1881) Type from Martaban.

THAILAND Pref. Chiangrai: northern slope of Doi Pacho, *K. Iwatsuki* & *N. Fukuoka* T. 3653 (KYO). Pref. Chiangmai: middle elevation of Doi Inthanon, *M. Tagawa*, *K. Iwatsuki* & *N. Fukuoka* T. 2589 (KYO; TNS); higher elevation of Doi Sutep, *K. Iwatsuki* & *N. Fukuoka* T. 4485 (KYO); higher elevation of Doi Chiangdao, *M. Tagawa*, *K. Iwatsuki* & *N. Fukuoka* T. 4141 (KYO). Pref. Loey: Phu Kradung, *M. Tagawa*, *K. Iwatsuki* & *N. Fukuoka* T. 476, 881 (KYO; TNS).

Distribution: Burma and northern Thailand; on grassy field in thin forest and on steep slope of limestone region of Doi Chiangdao.

Senecio kunthianus WALL. ex DC. Prod. VI: 369 (1837) Type from Emoko Kumaon; HOOK. f. Fl. Brit. Ind. III: 354 (1881).

INDIA Between Chitkul and Ranikanda, Kinnaur distr., *N. C. Nair* 34402 (TI).

Distribution: Kashmir to Sikkim.

Senecio densiflorus WALL. ex DC. Prod. VI: 369 (1837) Type from Nepal;

Hook. f. Fl. Brit. Ind. III : 355 (1881); KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 271 (1955), in HAHA Fl. East. Himal. 343 (1966).

The present species is fairly variable in some of the taxonomic characters.

Var. **densiflorus**

CHINA Prov. Yunnan : Wen-shan Hsien, *unknown collector* 51492 (TAI). BHUTAN Between Similaca and Kyapcha Dzong, *S. Nakao* 438 (KYO); near Tongu, *S. Nakao* 441 (KYO). SIKKIM J. D. Hooker (TNS); Gangtok, Orchid Sanctuary, *H. Hara* 6300198 (TI). E-INDIA Darjeeling : Birch hill, *H. Hara* & *S. Kurosawa* 6300311 (TI). E-NEPAL Helok-IIadanda, *H. Kanai*, *G. Murata* & *M. Togashi* 6306359 (TI; KYO); near Chyangthaphu - Birwa, *H. Kanai*, *G. Murata* & *M. Togashi* 6306361 (TI; KYO); Ghatte, *H. Hara* 6306360 (TI; KYO); Garhi Danra - Tuwa, *H. Hara et al.* 6306362 (TI; KYO). PUNJAB Kulu valley, Malana valley, *J. Tanaka* 89 (KYO).

Distribution : From Punjab to upper Burma, in the Himalayas, 1800 - 2400 m alt.

Var. **pubescens** KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 271 (1955), in HARA Fl. East. Himal. 344 (1966) Type : Nepal Camp near Karche, *S. Nakao* (Holotype in KYO).

NEPAL Bagarchap, *T. Fujimura* (KYO); Marshandi river, around Pasture, *S. Nakao* (KYO); near Lete, *K. Nishioka* 190 (KYO); between Bee and Namuru, *T. Namba* 1006035-2 (KYO); Bhandukay - Ghatte, *H. Hara*, *S. Kurosawa* & *T. Tuyama* 6306357 (TI; KYO); Baroya Khimty - Thakma Khola, *H. Hara*, *S. Kurosawa* & *T. Tuyama* 6306352 (TI; KYO); Hati Sar - Minchin Dhap, *H. Hara et al.* 6306353, 6306355 (TI; KYO); Sinduwa, Bhanjang, *H. Hara* 6306351 (TI; KYO; TNS); Sinduwa, Dhnankuta distr., *H. Hara et al.* 6306358 (TI; KYO).

Distribution : Nepal Himalayas ; 2000 - 2900 m alt.

This variety differs from the type variety in having pubescent achenes.

Senecio rufinervis DC. Prod. VI : 369 (1837) Type from eastern India ; HOOK. f. Fl. Brit. Ind. III : 355 (1881).

PUNJAB Kulu valley, Malana valley, *J. Tanaka* 89 (KYO). E-INDIA Rahla, *M. A. Rav* 12723 (TI).

Distribution : Himalayas, from Simla to Kumaon.

The following species may be referred to this series.

Senecio bhot CLARKE, Comp. Ind. 187 (1876) Type from Bhutan ; HOOK. f. Fl. Brit. Ind. III : 355 (1881).

Senecio prionophyllum FRANCH. in MOROT Journ. Bot. 10 : 420 (1896) Type from Prov. Yunnan, China.

Senecio simonsii CLARKE, Comp. Ind. 187 (1876) Type from Assam ; HOOK. f. Fl. Brit. Ind. III : 356 (1881).

Senecio tsoongianus LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5 : 26 (1937) Type from Prov. Yunnan, China.

Senecio vagans WALL. ex DC. Prod. VI : 368 (1837) Type from Nepal ; HOOK. f. Fl. Brit. Ind. III : 356 (1881).

Sect. **Jacobaea** DC. Prod. VI : 348 (1837); KITAM. Comp. Jap. III : 244

(1942) incl. syn.; SCHISCHK. Fl. URSS, XXVI : 710 (1961).

Sect. *Pseudo-oliganthi* SOF. Izb. AN Azzerb. SSR. 88 (1957).

Sect. *Extremiorientales* SCHISCHK. Addenda, XXV : 883 in Fl. URSS, XXVI (1961).

About 40 species, widely distributed in temperate Eurasia.

Heads with bracteoles. Narrow tubes of corolla as long as the rest part. The lower cells of upper part of filament are larger than the upper cells. Anther bases more or less tailed, but not so longly tailed as in Sect. *Tephroseris*. Pappus longer than achenes.

Chromosome numbers are known as to the following species which are arranged in alphabetical order.

Species	n	2n	Investigator
<i>Senecio abrotanifolius</i>	20		AFZELIUS 1924.
<i>Senecio adonidifolius</i>	20		"
<i>Senecio alpinus</i>	20		"
(under <i>S. cordifolius</i>)			
<i>Senecio ambraceus</i>	20		" 1949.
<i>Senecio aquaticus</i>	20		"
<i>Senecio argunensis</i>	20		"
"		40	ZHUKOVA 1964 in CAVE 1965.
<i>Senecio cannabifolius</i>		36	SUZUKA & K. 1949.
"		40	ARANO 1962.
"	20, 40		OKABE 1931.
(under <i>S. palmatus</i>)			
		ca. 80	SOKOLOVSKAYA 1963 in CAVE 1964.
		40	ZHUKOVA 1964 in CAVE 1965.
<i>Senecio doria</i>	20		AFZELIUS 1924
<i>Senecio erucifolius</i>	20		"
<i>Senecio fluvialis</i>	20		"
<i>Senecio foliosus</i>	20		"
<i>Senecio jacobaea</i>	20		" ; ORNDUFF et al. 1963.
"		32, 40	BÖCHER & L. 1955.
"		40	MULLIGAN 1959 in CAVE 1960.
<i>Senecio nemorensis</i>	20	40	MATSUURA & S. 1935.
"		40	ARANO 1964; ZHUKOVA 1964 in CAVE 1965.
"	40		CHUANG et al. 1963.
(under <i>S. angustifolius</i>)			
"	20		AFZELIUS 1924.
(under <i>S. fuchsii</i>)			
"		40	GADELLA & K. 1963 in CAVE 1964.
<i>Senecio paludosus</i>	20		AFZELIUS 1924.
<i>Senecio praealtus</i>	20		"
<i>Senecio rhombifolius</i>		38	LESKOVA et al. 1964 in CAVE 1965.
<i>Senecio schwetzowii</i>	20		AFZELIUS 1967.

<i>Senecio subalpinus</i>	20	AFZELIUS 1924.
<i>Senecio umbrosus</i>	20	"

Key to the species

- A. Annuals ; disk florets very slender, 3-lobed at apex. *S. ramosus*.
- A. Biennials or perennials ; disk florets campanulate, 5-lobed at apex. B.
- B. Leaves undivided, toothed. C.
- B. Leaves pinnately parted. E.
- C. Leaves narrow, less than 10 mm in width. D.
- C. Leaves not narrow. *S. nemorensis*.
- D. Achenes glabrous ; leaves more or less wide. *S. craibianus*.
- D. Achenes papillose or scabrid ; leaves very narrow, linear. *S. griffithii*.
- E. Pinnate lobes 1-3 pairs, apparently palmate. *S. cannabifolius*.
- E. Pinnate lobes more than 4 pairs, lyrate pinnatifid. F.
- F. Achenes pubescent. G.
- F. Achenes glabrous. I.
- G. Involucral scales 7 mm in length. *S. ambraceus*.
- G. Involucral scales 5 mm in length. H.
- H. Ligules 5-6 in a head. *S. morrisonensis*.
- H. Ligules more than 10 in a head. *S. argunensis*.
- I. Ray florets 3-5, involucral scales 5-7. *S. graciliflorus*.
- I. Ray florets more than 8, involucral scales more than 10. J.
- J. Heads with many linear bracteoles. *S. albopurpureus*.
- J. Heads with 2-3 bracteoles. K.
- K. Involucral scales 5 mm in length. *S. chrysanthemoides*.
- K. Involucral scales 7 mm in length. *S. manshuricus*.

Senecio ramosus WALL. ex DC. Prod. VI : 365 (1837) Type from Silhet, India ; KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 271 (1955).

NEPAL Suburb of Katmandu, *S. Nakao* (KYO).

Distribution : Himalayas, 1400 m alt.

Senecio nemorensis L. Sp. Pl. II : 870 (1753) Type from Germany ; KITAM. Comp. Jap. III : 245 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 255 (1952) ; OHWI, Fl. Jap. Eng. ed. 887 (1965).

The present species has its wide distribution in Eurasia and has many geographical races.

var. **dentata** (KITAM.) KOYAMA comb. nov.

Senecio morrisonensis var. *dentata* KITAM. in Acta Phytotax. Geobot. 6 : 274, 1, c. 9 : 38 (1940), Comp. Jap. III : 247 (1942). — *Senecio angustifolius* HAYATA, Mater. Fl. Formos. 154 (1911), Type : Taiwan Prov. Tainan : Mt. Ganzan in mts. Niitaka, *S. Nagasawa* 643 (Holotype in TI), non WILLD. (1797), nec WALL. ex DC. (1837).

Senecio angustifolius may better be referred to the present species, though this was treated as a variety of *S. morrisonensis* by KITAMURA. According to my field observation of this variety, the leaves are very narrow and sometimes dissected. Both var. *dentata* and var. *nemorensis* were often found in the same

habitat in Taiwan, thought var. *dentata* is absent in Japan.

Senecio craibianus Hoss. in Bot. Centralb. Bih. 28 (2): 454 (1911) Type from Doi Chiengdao in Thailand; KERR, Fl. Siam. Enum. II: 291 (1936).

THAILAND Pref. Chiangrai: northern slope of Doi Pacho, *K. Iwatsuki & N. Fukuoka* T. 3639 (KYO; TNS). Pref. Chianmai: higher elevation of Doi Chiangdao, *M. Tagawa, K. Iwatsuki & N. Fukuoka* T 4143 (KYO; TNS), N-slope of Doi Chiangdao, *T. Smitinand* 4239 (BKF; TNS).

Distribution: northern Thailand, on rocks of higher elevation, 1300 - 2000 m alt.

Senecio griffithii Hook. f. et THOMS. ex CLARKE, Comp. Ind. 193 (1876) Type from Khasia in Assam; Hook. f. Fl. Brit. Ind. III: 341 (1881).

ASSAM Cherrapunji, Khasia hills, *H. Kihara & S. Nakao* (KYO).

Distribution: eastern Himalayas; 1500 - 2200 m alt.

Senecio cannabifolius LESS. in Linnaea, 6: 242 (1831) Type from Kamtchatka; KITAM. Comp. Jap. III: 348 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II: 253 (1952); OHWI, Fl. Jap. Eng. ed. 887 (1965); SCHISCHK. Fl. URSS, XXVI: 747 (1961).

Three varieties are arranged in this species.

Var. **cannabifolius**

The present variety has fairly wide distribution in northeastern Asia. Leaves of this variety are pinnatifid, always having one to three pairs of lobes.

Var. **integrifolius** (KOIDZ.) KITAM. in Acta Phytotax. Geobot. 6: 275 (1937), Comp. Jap. III: 249 (1942); HARA, Enum. Sperm. Jap. II: 253 (1952); OHWI, Fl. Jap. Eng. ed. 886 (1965). — *Senecio palmatus* var. *integrifolius* KOIDZ. in Bot. Mag. Tokyo, 30: 77 (1916) Type: Honshu Pref. Yamagata: Mt. Nishiazuma, *G. Koidzumi* (Holotype in TI).

Leaves are not divided, but toothed at the margin.

Var. **paludosus** TATEWAKI, Rep. Veg. Is. Shikotan, 56 (1940) Type: Kuriles Shakotan in Isl. Shikotan, *S. Ohno* (Holotype in SAP).

This variety is characterized by dwarf stem with linear-lanceolate leaves.

Senecio ambraceus TURCZ. ex DC. Prod. VI: 348 (1837) Type from Mongolia; KITAM. Comp. Jap. III: 250 (1942) excl. var. *glaber*, in Journ. Jap. Bot. 21: 55 (1947); SCHISCHK. Fl. URSS, XXVI: 715 (1961).

MANSHURIA Prov. Kokuryuko: Ilikoteh, *J. Sato* 1136 (KYO). CHINA Prov. Hupeh: Sikikwai, *M. Togashi* 2245 (TNS).

Distribution: Manshuria and northern China.

Senecio morrisonensis HAYATA, Mater. Fl. Formos. 155 (1911) Type: Taiwan Prov. Tainan: Mt. Niitaka, *T. Kawakami & U. Mori* 2270 (Holotype in TI); KITAM. Comp. Jap. III: 247 (1942) excl. var. *dentata*.

Endemic to Taiwan; in moist grassy places in alpine regions.

Senecio argunensis TURCZ. in Bull. Soc. Nat. Mosc. XX: 18 (1847) Type: Argun Manchuria; KITAM. Comp. Jap. III: 250 (1942), in Journ. Jap. Bot. 21: 55 (1947).

Two varieties are arranged by KITAMURA.

Var. **argunensis**

Distribution : Dauria, Manshuria, northern China, Korea and northern Kyushu.

Var. **pilosa** KITAM. in Journ. Jap. Bot. 21 : 55 (1947) Type : Korea Prov. Kanhoku : inter Koko et Sancho, *G. Koidzumi* (Holotype in KYO).

In this variety, achenes of disk florets are sparsely pubescent.

Senecio graciliflorus DC. Prod. VI : 365 (1837) Type from Gossain-Kunde in Nepal et Kumaon ; KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 271 (1955), in HARA Fl. East. Himal. 344 (1966).

NEPAL Marshandi river, around Pastur, *S. Nakao* (KYO). E-NEPAL Sinduwa, Dhyankuta distr., *H. Hara* 6306363 (TI; KYO); Minchin Dhap - Mul Pokhari, near Tapplejung, *H. Hara* 6306364 (TI; KYO); Selap - Walunchung Gola, *H. Kanai*, *G. Murata* & *M. Togashi* (TI); Zongi - Iladanda, *H. Kanai* et al. 6306365 (TI; KYO). BHUTAN Gosa Dzong, *S. Nakao* 122 (KYO). CHINA Mt. Omi, *E. H. Wilson* 4966 (TNS).

Distribution : Himalayas from Kashmir to Bhutan ; 1600 - 2900 m alt.

Senecio albopurpureus KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 271 (1955). — *Senecio bracteolatus* HOOK. f. Fl. Brit. Ind. III : 339 (1881) Type from Sikkim Himalaya, non HOOKER & ARNOTT (1841).

NEPAL between Chaikia and Kalun, *S. Nakao* (KYO; TI); between Lhonak and Pangpema, *K. Nishioka* 1087 (KYO); Tamur valley, Kambachen, E of Walungchung Gola, *J. D. A. Stainton* 1148 (TNS).

Distribution : Himalayas, from Sikkim to Nepal ; 4000 - 4800 m alt.

Senecio chrysanthemoides DC. Prod. VI : 365 (1837) Type from Gossain-Kunde et Kumaon in Nepal ; KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 271 (1955), in HARA Fl. East. Himal. 343 (1966).

The present species is one of the Himalayan elements, and occurs in the temperate zone of Himalayas from Afghanistan to southern China. This species varies considerably. Thus, several infraspecific taxa are recognized.

Var. **chrysanthemoides**

CHINA Prov. Yunnan : Megtze mts., *A. Henry* 10008 A (TNS). BHUTAN Sele La, *S. Nakao* 163 (KYO). PUNJAB Kulu valley, Malana valley, *J. Tanaka* 52 (KYO). NEPAL Near Gola, *K. Nishioka* 233; ibidem, *S. Nakao* 259 (KYO); Mu, *O. Namikawa* 103; between Phah and Hshimen, *O. Namikawa* 105 (KYO); near Sikha, *S. Nakao* (KYO); Phulbe, *S. Nakao* (KYO; TNS; TI); Pö, *K. Nishioka* 199 (KYO); near Gorepani, *K. Nishioka* 329, 333 (KYO); Chagma, *M. Numata* 1518 (KYO). E-NEPAL Sinduwa, Dhyankuta distr., *H. Hara* et al. 6306349 (TI; KYO); Minchin Dhap - Mul Pokhari, *H. Hara* et al. 6306350 (TI); Hati Sar - Minchin Dhap, *H. Hara* et al. (TI). E-INDIA Darjeeling : Tonglu, *H. Hara* (TI).

Var. **analogus** (DC.) HOOK. f. Fl. Brit. Ind. III : 339 (1881); KITAM. Fl. Afghan. 444 (1960). — *Senecio analogus* DC. Prod. VI : 366 (1838) Type from Himalayas.

AFGHANISTAN Nuristan : Eschtaway, *S. Kitamura* (KYO); between Ku-

shitaki and Pronz, *S. Kitamura* (KYO); Shabul Gul, *S. Kitamura* (KYO).

Var. **spectabilis** DC. Prod. VI : 366 (1838); Hook. f. Fl. Brit. Ind. III : 339 (1881); KITAM. in HARA Fl. East. Himal. 343 (1966).

E-NEPAL Mangalbare - Lam Pokhari, *H. Hara et al.* 6306348 (TI ; KYO); Minchin Dhap - Mul Pokhari, *H. Hara et al.* (TI).

Senecio manshuricus KITAM. in Journ. Jap. Bot. 21 : 55 (1947) Type : Korea Prov. Heihoku : Gishu, *G. Koidzumi* (Holotype in KYO).

MANSHURIA Prov. Hohten : Tokuriji, *Noda* (KYO); ibidem, *M. Suko* (KYO); Gabiso, *S. Kitamura* (KYO); Shiheigai, *Noda* (KYO); Tetsuryo, *K. Numajiri* 208 (KYO). Prov. Ryuko : Ryuko-mura, Chinto-ken, *T. Takano* 17 (TNS). Ohri, *M. Kato* 5216 (KYO). CHINA Prov. Hupei : Pekin, *collector unknown* 8092 (TNS); ibidem, *S. Miki* (KYO). Prov. Shantung: Chintao, *S. Miki* (KYO). KOREA Prov. Heihoku : Gishu, *G. Koidzumi* (KYO).

Distribution : northern China, Manshuria and northern Korea.

The following species are referable to this section.

Senecio acromaculus LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5 : 18 (1937). — *Senecio thianschanicus* MATTF. in Journ. Arnold Arb. 14 : 39 (1913) Type from central Asia, non REGEL et SCHMALH. (1879).

Senecio actinotus HAND.-MZT. Symb. Sin. VII : 1121 (1936) Type from SW-Hunan, China.

Senecio diversifolius WALL. ex DC. Prod. VI : 366 (1837) Type from Nepal.

Senecio diversipinnus LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5 : 21 (1937) Type from Kansu, China.

Senecio euosmus HAND.-MZT. in Sitzgsanz. Ak. W. W. 72: 148 (1925) Type from NW-Yunnan, China.

Senecio nudicaulis HAMILT. ex D. DON, Prod. Fl. Nepal. 179 (1825) Type from Nepal.

Senecio obtusatus WALL. ex DC. Prod. VI : 367 (1837) Type from Khasia.

Senecio tetrandrus HAMILT. ex DC. Prod. VI : 365 (1837) Type from eastern India.

Sect. **Crociseris** REICHB. Fl. Germ. Exc. 242 (1831); KITAM. Comp. Jap. III : 251 (1942).

Plants rather fleshy. Heads with bracteoles, few in number, large in diameter. Narrow tube of corolla is of the same length with the rest part of corolla. Anther bases obtuse. The lower cells of upper part of filament are larger than the upper cells.

The present section comprises about 40 species and distributes fairly widely in the temperate zones of Eurasia and North America. In our region, however, only one species occurs.

Chromosome numbers of the following species are reported by various investigators.

Species	n	2n	Investigator
<i>Senecio amphibolus</i>	20		AFZELIUS 1949.
<i>Senecio doronicum</i>	40		"

"	40	GUINOCHE & L. 1962 in CAVE 1963.
<i>Senecio pseudo-arnica</i>	20	OKABE 1931.
"	20	ARANO 1964.
"	38-40	SOKOLOVSKAYA 1963 in CAVE 1964.
"	36	ZHUKOVA 1964 in CAVE 1965.
<i>Senecio racemosus</i>	20	AFZELIUS 1949, 1967.

Senecio pseudo-arnica LESS. in Linnaea, 6 : 240 (1831) Type from Kamtschatka and Arctic America ; KITAM. Comp. Jap. III : 252 (1942); HARA, Enum. Sperm. Jap. II : 257 (1952); SCHISCHK. Fl. URSS, XXVI : 723 (1961); OHWI, Fl. Jap. Eng. ed. 886 (1965).

Two varieties are acceptable.

Var. **pseudo-arnica**

Distribution : northeastern Asia and northern North America ; on sea beaches.

Var. **kurilensis** KUDO in Journ. Agric. Hokk. Imp. Univ. 11, Part 2 : 171 (1922) Type : Kuriles Paramushir : Ottomoi, S. Yokoyama (Holotype in SAP); KITAM. Comp. Jap. III : 253 (1942); HARA, Enum. Sperm. Jap. II : 257 (1952).

Endemic to northern islands of Kuriles.

References of Chromosome numbers

- AFZELIUS, K. 1924. Embryologische und Sytologische Studien in *Senecio* und verwandten Gattungen. *Acta Hort. Berg.* 8 : 123 - 219.
- AFZELIUS, K. 1949. On chromosome numbers in *Senecio* and some allied genera. *Acta Hort. Berg.* 15 : 65 - 77.
- ARANO, H. 1962. Cytological studies in subfamily Carduoideae (Compositae) of Japan VIII. The karyotype analysis in tribe Senecioneae. *Bot. Mag. Tokyo*, 75 : 401 - 410.
- ARANO, H. 1964. Cytological studies in subfamily Carduoideae (Compositae) of Japan XVI. The karyotype analysis in tribe Senecioneae. *Bot. Mag. Tokyo*, 77 : 59 - 65.
- ARANO, H. 1965. The karyotypes and the speciations in subfamily Carduoideae (Compositae) of Japan, XVIII. *Jap. Journ. Bot.* 19 : 31 - 67.
- BÖCHER, T. W. & K. LARSEN, 1955. Chromosome studies on some European flowering plants. *Bot. Tidsskr.* 52 : 125 - 132.
- CHUANG, T.-I., C. Y. CHAO, W. L. H. WILMA & S. C. KWAN, 1962. Chromosome numbers of the vascular plants of Taiwan. *Taiwania*, 8 : 51 - 66.
- GADELLA, T. W. J. & K. KLIPHUIS, 1963. Chromosome numbers of flowering plants in the Netherlands. *Acta Bot. Neerl.* 12 : 195 - 230.
- ISHIKAWA, M. 1916. A list of the number of chromosomes. *Bot. Mag. Tokyo*, 30 : 404 - 448.
- KOYAMA, H. 1965. On the chromosome number of *Senecio nikoensis*. *Acta Phytotax. Geobot.* 21 : 132.
- KOYAMA, H. 1966. Chromosome numbers in some species of Compositae. *Acta Phytotax. Geobot.* 22 : 80.
- MATSUURA, H. & T. SUTO, 1935. Contributions to the Idiogram study in Phane-

- rogamous plants I. *Journ. Fac. Sci. Hokkaido Imp. Univ. Series V. Bot.* 5 : 33 - 75.
- MULLIGAN, G. A. 1959. Chromosome numbers of Canadian weeds. II. *Canad. Journ. Bot.* 37 : 81 - 92.
- OKABE, S. 1931. Über die Polyploidie der Gattung *Senecio*. *Bot. Mag. Tokyo*, 45 : 258 - 260.
- ORNDUFF, R., P. H. RAVEN, D. W. KYHOS & A. R. KRUCKEBERG, 1963. Chromosome numbers in Compositae. III. Senecioneae. *Amer. Journ. Bot.* 50 : 131 - 139,
- RUTLAND, J. P. 1941. The Merton catalogue. A list of chromosome numbers of British plants. Supplement No. 1. *New Phytol.* 40 : 210 - 214.
- SOKOLOVSKAJA, A. P. 1963. Geographical distribution of polyploidy in plants. (Investigation of the flora of the Kamchatka Peninsula). *Vest. Leningrad. Univ. No. 15 Ser. Biol.* : 38 - 52.
- SOKOLOVSKAJA, A. & O. STRELKOVA, 1938. in Chromosome atlas of flowering plants edited by DARLINGTON & WYLIE (1955).
- SOKOLOVSKAJA, A. P. & O. STRELKOVA, 1960. Geographical distribution of the polyploid species of plants in the Eurasian Arctic. *Bot. Zhur. SSSR.* 45 : 369 - 381.
- SUZUKA, O. & S. KORIBA, 1949. Chromosome numbers of medicinal plant. I. *Jap. Journ. Pharmacog.* 3 : 68.
- ZHUKOVA, P. G. 1964. The caryology of some species of Compositae growing in the Arcto-Alpine Botanic Garden (Kola Peninsula). *Bot. Zhur.* 49 : 1656-1659.

Genus *Dendrocacalia*

Dendrocacalia is shrubby and has been considered as a monotypic genus. This genus is characterized by having the discoid head with 5 involucral scales and 5 florets, and pale rosy-purple flowers. The form of style branches of this genus are more or less similar to that of *Senecio*, but the cellular construction of achene hair of this genus is quite different from that of *Senecio* and its allied of our region. Considering these characters, *Dendrocacalia* is phylogenetically different from other genera in our region.

Dendrocacalia NAKAI ex TUYAMA in *Bot. Mag. Tokyo*, 50 : 129 (1936); KITAM. Comp. Jap. III : 228 (1942); HARA, Enum. Sperm. Jap. II : 192 (1952).

Woody perennial, about 1.5 - 4 m in height. Trunk 5 - 10 cm in diameter, very much branched. Leaves alternate, ovate or oblanceolate, entire, glabrous on both surfaces, pinnately veined. Inflorescences corymbose. Heads discoid with bracteoles; involucral scales equal, 1-seriate, 5 in number, 5 florets in a head. Florets hermaphrodite, fertile, tubular, 5-lobed at apex, pale rosy-purple. Anther bases subentire or obtuse. The lower cells of the upper part of filament are larger than the upper cells. Style branches truncate, papillate beneath, hairy at Achenes tip. densely pubescent, with white pappus.

Dendrocacalia crepidifolia (NAKAI) NAKAI in *Bull. Biogeogr. Soc. Jap.* 1 : 264 (1930); TUYAMA in *Bot. Mag. Tokyo*, 50 : 129 (1936); KITAM. Comp.

Jap. III : 229 (1942); HARA, Enum. Sperm. Jap. II : 192 (1952). — *Cacalia crepidifolia* NAKAI in Bot. Mag. Tokyo, 29 : 12 (1915) Type: Bonin, R. *Yatabe & T. Uchiyama* (Holotype in TI).

Endemic to Bonin Island ; growing on the margin of woods.

Genus **Emilia**

Emilia is a small tropical genus described by CASSINI. The taxonomical status of this has been given by most investigators as a separate genus, though it differs obscurely from *Senecio*.

Emilia CASS. in Bull. Soc. Philom. 1817 : 68 (1817), in Dict. Sci. Nat. 14 : 405 (1819) Type: *E. flammea*; KITAM. Comp. Jap. III : 178 (1942); HARA, Enum. Sperm. Jap. II : 194 (1952); OHWI, Fl. Jap. Eng. ed. 879 (1965).

Annual, biennial or perennial herbs, often glaucous, glabrous or hairy. Leaves radical crowded, petioled, the margin entire, toothed or lyrate-pinnatifid; caudine few, stem-clasping. Inflorescences solitary or loosely corymbose. Heads long peduncled, without bracteoles at base, homogamous, discoid, yellow or reddish. Florets all hermaphrodite, fertile, tubular, narrow tube of corolla elongate, 5-lobed at apex. Anther bases truncate. The lower cells of upper part of filament are larger than the upper cells. Style branches long, truncate, hairy at tip. Achenes 5-ribbed or rarely terete, with soft, snow-white pappus.

About twenty species known at present, three species occur in our region. They are distinguished from each other as :

- A. Involucral scales shorter than the florets ; achenes glabrous. *E. prenanthoidea*.
- A. Involucral scales equal to the florets ; achenes pubescent. B.
- B. Stem and leaves subglabrous *E. sonchifolia*.
- B. Stem and leaves densely crispat pilose *E. scabra*.

Emilia sonchifolia (L.) DC. Prod. VI : 302 (1837); KITAM. Comp. Jap. III : 178 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II : 194 (1952); OHWI, Fl. Jap. Eng. ed. 879 (1965). — *Cacalia sonchifolia* L. Sp. Pl. II : 835 (1753) Type from Ceylon.

This variable species is widely distributed in subtropical and tropical zones of Eurasia and Africa, and introduced into central America. Various forms of this species are established according to the habitats.

Chromosome number: $n = 5$ (AFZELIUS 1924; BALDWIN & S. 1949; TURNER & K. 1964). $n = 5$, $2n = 10$ (BALDWIN 1946). $n = 10$, $2n = 20$ (ARANO 1962 a). $2n = 20$ (KOYAMA 1967).

Emilia scabra DC., Prodr. VI : 303 (1838); GAGNEP. Fl. génér. Indochine III : 518 (1924).

Emilias onchifolia DC. var. *scabra* HOOKER f. Fl. Brit. Ind. III : 336 (1881).

VIETNAM Dalat B. Hayata (TI). ASSAM Khasia Hills, Cherrapunji, S. Nakao (KYO).

Distribution : India to Vietnam.

Emilia prenanthoidea DC. Prod. VI : 303 (1837) Type from Silhet in eastern India; Hook. f. Fl. Brit. Ind. III : 336 (1881).

CHINA Prov. Kwangtung : Sam-Kok-shan, Tsungfa-Lungmoon distr., *W. T. Tsang* 20456 (KYO; TI). VIETNAM Annan Dran, *B. Hayata* (TI). Chapa, *B. Hayata* (TI).

References of Chromosome numbers

- AFZELIUS, K. 1924. Embryologische und Zytologische Studien in *Senecio* und verwandten Gattungen. *Acta Hort. Berg.* 8 : 123 - 219.
- ARANO, H. 1962. Cytotaxonomic studies in subfamily Carduoideae of Japanese Compositae. V. Karyotype analysis and its karyological considerations in some genera. *La Kromosomo.* 53-54: 1794 - 1810.
- BALDWIN, J. T. 1946. Cytogeography of *Emilia* Cass. in the Americas. *Bull. Torrey Bot. Cl.* 73 : 18 - 23.
- BALDWIN, J. T. & B. M. SPEESE, 1949. Cytogeography of *Emilia* in West Africa. *Bull. Torrey Bot. Cl.* 76 : 346 - 351.
- ISHIKAWA, M. 1916. A list of the number of chromosomes. *Bot. Mag. Tokyo,* 30 : 404 - 448.
- KOYAMA, H. 1967. Taxonomic studies on the tribe Senecioneae of Eastern Asia I. General part. *Mem. Coll. Sci. Univ. Kyoto, Series B.* 33 : 183 - 209.
- TURNER, B. L. & H. S. IRWIN, 1960. Chromosome numbers in the Compositae II. Meiotic counts for fourteen species of Brazilian Compositae. *Rhodora,* 62 : 122 - 126.
- TURNER, B. L. & R. M. KING, 1964. Chromosome numbers in the Compositae VIII. Mexican and central American species. *Southwest. Nat.* 9 : 27 - 39.

Genus *Syneileisis*

Syneileisis has a close affinity to *Cacalia*, but is clearly distinguished from the latter by having a single cotyledon which is orbiculate and convolute.

Being unique among Compositae, this character is, at least practically, convenient for circumscribing the present genus.

The present genus distributes exclusively in eastern Asia : eastern China, Taiwan, Manshuria, Korea and Japan excluding Hokkaido.

Syneileisis MAXIM. Prim. Fl. Amur. 165 t. VII, figs. 8 - 18 (1859) Type: *S. aconitifolia*; KITAM. Comp. Jap. III : 170 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II : 264 (1952); POJARKOVA, Fl. URSS, XXVI : 697 (1961); OHWI, Fl. Jap. Eng. ed. 887 (1965).

Perennial herbs, with creeping rhizomes. Leaves few, usually two, with long petioles, peltate, palmately lobed. Head discoid, with bracteoles at base, homogamous. Florets all hermaphrodite, fertile, tubular, 5-lobed at apex, white. Anther bases tailed. The lower cells of upper part of filament are larger than the upper cells. Style branche long, truncate, hairy at tip and beneath for their entire length. Achenes cylindric, tapered off at both ends, glabrous, with soft, snow-white or drab pappus.

Key to the species

- | | |
|-----------------------------------|----|
| A. Inflorescences corymbose | B. |
| A. Inflorescences thyrsoid. | D. |

- B. Leaf segments narrow, mostly 4 - 8 mm in width. *S. aconitifolia*.
- B. Leaf segments wider than 8 mm. *C.*
- C. Plants sometimes with bulbils ; pappus reddish. *S. intermedia*.
- C. Plants without bulbils ; pappus tawny. *S. tagawae*.
- D. Leaves small 15-20(-25), cm in diameter. *S. subglabrata*.
- D. Leaves large, mostly more than 30 cm in diameter. *S. palmata*.

Syneilesis aconitifolia (BUNGE) MAXIM. Prim. Fl. Amur. 165 (1859); KITAM. Comp. Jap. III : 170 (1942); HARA, Enum. Sperm. Jap. II : 264 (1952); POJARKOVA, Fl. URSS, XXVI : 698 (1961); OHWI, Fl. Jap. Eng. ed. 887 (1965). — *Cacalia aconitifolia* BUNGE, Enum. Pl. Chin. Bor. 37, n. 208 (1831) Type form China.

Two varieties are arranged by KITAMURA.

Var. **aconitifolia**

Chromosome number : $n = 26$ (AFZELIUS 1949).

Distribution : Manshuria, northern China and Korea ; in light forest of mountainous region.

Var. **longilepis** KITAM. in Journ. Jap. Bot. 10 : 701 (1934) Type : Honshu Pref. Kyoto : around the watershed at Gomagahara, Gomago-mura, Funai-gun, Y. Araki (Holotype in KYO).

The present variety is one of the interesting taxa characterized by having narrow leaf segments and compound corymb like the typical variety, though this differs from the typical variety in the longer involucres. No additional material has been obtained since the type collection.

Syneilesis intermedia (HAYATA) KITAM. in Acta Phytotax. Geobot. 6 : 244 (1937), Comp. Jap. III : 172 (1942). — *Senecio intermedius* HAYATA in MATSUM. & HAYATA Mater. Fl. Formos. 155 (1911) Type : Taiwan Prov. Shinchiku : at the vicinity of Biyortsu, U. Faurie 202 (Holotype in TI and Isotype in KYO), non Wight (1840), nec Wiesb. (1874).

Endemic to Taiwan ; on grassy field in light forest, 300 - 500 m alt.

The present species is known as a medicinal herb in Taiwan, though no information is available as to its efficacy.

Syneilesis tagawae (KITAM.) Comp. Jap. III : 171 (1942); HARA, Enum. Sperm. Jap. II : 265 (1952); OHWI, Fl. Jap. Eng. ed. 887 (1965); KOYAMA in Acta Phytotax. Geobot. 21 : 129 (1965). — *Cacalia aconitifolia* var. *tagawae* KITAM. Comp. Nov. Jap. I : 24 (1931) Type : Shikoku Pref. Kochi : Nakanokawa, Nakayama-mura, Aki-gun, M. Tagawa (Holotype in KYO).

As has been already reported, two types of chromosomes are observed in the present species : one having 52 chromosomes and the other 78. Judging from both the behaviour and the morphology of chromosomes, the plants with 78 chromosomes can be considered as auto-triploid. Considering some characters of the specimens whose chromosomes were counted, *S. tagawae* seems to be consisting of two races, and the type of the present species may belong to the group with 78-chromosomes. Thus, the present species may better be arranged into two varieties.

Var. **tagawae**

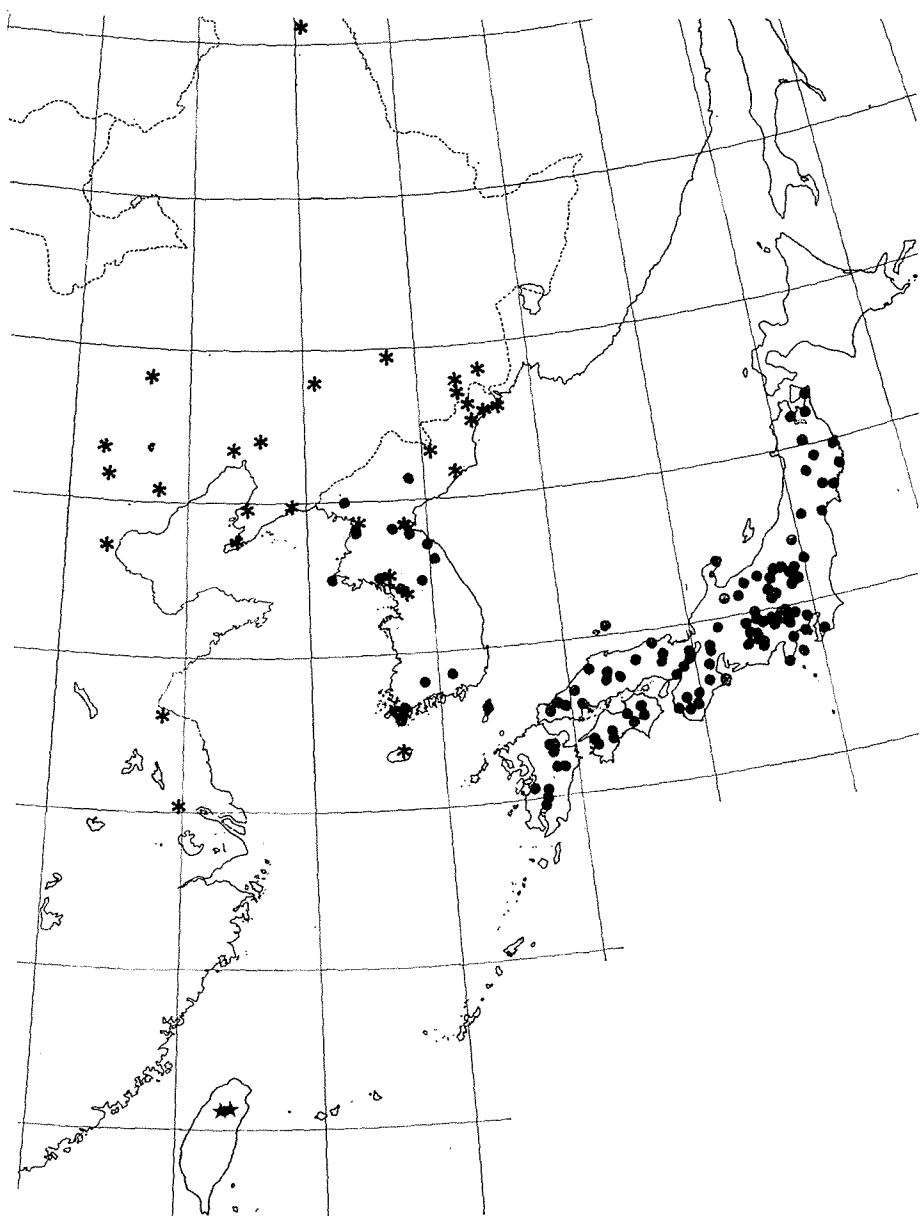


Fig. 5. Ranges of *Syneilesis aconitifolia* (*), *S. palmata* (●)
and *S. subglabrata* (★).

Leaf segments slightly dentate or nearly entire. Inflorescences divaricately branched. Chromosome number $2n = 78$ (3X).

SHIKOKU Pref. Kochi: Nishiharami, the southern part of Kochi-city, *H. Koyama* 1882— $2n = 78$, 1189 (KYO); ibidem, *T. Yamawaki* (KYO); Nakano-kawa, Nakayama-mura, Aki-gun, *M. Tagawa* (KYO).

Var. *latifolia* H. KOYAMA var. nov.

Folia palmatipartita, laciniis margine irregulariter argute serratis. Inflorescentia corymbosa, ramis erect-patentibus. Chromosomata $2n = 52$ (2X).

Typus: SHIKOKU Pref. Ehime: Inoo, Uwa-cho, Higashiuwa-gun, *Y. Nomura* 1 (Holotype in KYO).

SHIKOKU Pref. Kochi: at the garden of T. YAMAWAKI in Kochi-city, *H. Koyama* 1824— $2n = 52$ (KYO); Nakanokawa, Yasuda-cho, Aki-gun, *H. Koyama* 1844— $n = 26$, $2n = 52$ (KYO). Pref. Ehime: Inoo, Uwa-cho, Higashiuwa-gun, *Y. Nomura* 1 (KYO).

Syneileisis subglabrata (YAMAMOTO & SASAKI) KITAM. in Journ. Jap. Bot. 10 : 702 (1934), Comp. Jap. III : 173 (1942). — *Cacalia intermedia* var. *subglabrata* YAMAMOTO & SASAKI in Journ. Trop. Agr. 3 : 243 (1931) Type: Taiwan Prov. Taichu: Saramao, *S. Sasaki* (Holotype in TAI).

Endemic to Taiwan; on grassy slope in mountain region, 2000 - 2500 m alt. Chromosome number: $2n = 52$ (KOYAMA 1965).

Syneileisis palmata (THUNB.) MAXIM. in Mél. Biol. 9 : 300 (1874); KITAM. Comp. Jap. III : 173 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II : 264 (1952); OHWI, Fl. Jap. Eng. ed. 887 (1965). — *Arnica palmata* THUNB. Fl. Jap. 319 (1784) Type from Japan.

Distribution: Honshu, Shikoku, Kyushu, Korea and eastern China; on rather moist ground in mountain forest or rarely on grassy slope in mountains.

Chromosome number: $n = 26$ (KOYAMA 1961), $2n = 52$ (KOYAMA 1961; TAKESHITA 1961; ARANO 1964 a).

Following species was described from China.

Syneileisis australis LING in Contrib. Inst. Bot. Nat. Acad. Peiping, 5 : 5 (1937) Type from Prov. Chekiang.

Materials are not available. According to the notes given by LING, the present species stands between *S. aconitifolia* and *S. intermedia*.

References of Chromosome numbers

- AFZELIUS, K. 1949. On chromosome numbers in *Senecio* and some allied genera. *Acta Hort. Berg.* 15 : 65 - 77.
- ARANO, H. 1964. Cytological studies in subfamily Carduoideae (Compositae) of Japan XVII. The karyotype analysis in *Cacalia* and *Syneileisis*. *Bot. Mag. Tokyo*, 77 : 86 - 97.
- KOYAMA, H. 1961. Chromosome numbers in some Japanese species of *Cacalia* and the allied genera. *Acta Phytotax. Geobot.* 19: 18 - 19.
- KOYAMA, H. 1965. Cytotaxonomic studies of Compositae 1. Species problem on *Syneileisis tagawae*. *Acta Phytotax. Geobot.* 21 : 129 - 132.

Genus **Miricacalia**

Miricacalia described by KITAMURA is characterized by having beaked achenes and yellow flowers. The beaked achenes are clearly distinguished from the achenes without beaks in fully matured condition. All the genera of our tribe except for *Miricacalia* have the achenes without beaks. This genus is monotypic and endemic to Japan.

Miricacalia KITAM. in Acta Phytotax. Geobot. 5 : 214 (1938), Comp. Jap. III : 227 (1942); HARA, Enum. Sperm. Jap. II : 233 (1952); OHWI, Fl. Jap. Eng. ed. 882 (1965).

Perennial herbs, about 50 - 80 cm in height, curled-downy hairs consisting of 10 - 14 cells. Leaves 2 - 3 in number, palmate, peltate, hairy on vein beneath. Inflorescences racemose. Flowers open in turn from the basal heads to the apical one. Heads with bracteoles, discoid, homogamous. Florets all hermaphrodite, fertile, tubular, yellow, 5-lobed at apex. Anther bases auri-cled. The lower cells of upper part of filament are larger than the upper cells. Style branches long, truncate, hairs at tip and beneath for their entire length. Achenes cylindric, tapered off at both ends, forming short beaks at upper end, glabrous, with pappus.

Miricacalia makineana (YATABE) KITAM. in Acta Phytotax. Geobot. 5 : 214 (1936), Comp. Jap. III : 227 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II : 233 (1952); OHWI, Fl. Jap. Eng. ed. 882 (1965). — *Senecio makineanus* YATABE in Bot. Mag. Tokyo, 6 : 115 t. 3 (1892), Icon. Pl. Jap. I - III : 184 t. 45 (1894) Type: Shikoku Pref. Kochi: Mt. Tsue-yama, Nanokawa-mura, K. Watanabe 1884 (Holotype in TI).

The leaves of this species are palmate as those of *Cacalia delphinifolia*. The petioles of this species are perfectly circular in a transverse section and are attached to the lamina, not at the margin but inside, though the leaves are palmate as those of *C. delphinifolia*.

Endemic to Japan: Kyushu, Shikoku and southern Honshu; on humus in mountain forest, 700 - 1500 m alt.

Chromosome number: $n = 27$ (KOYAMA 1967). $2n = 52$ (TAKESHITA 1961), $2n = 54$ (KOYAMA 1961).

References of Chromosome numbers

- KOYAMA, H. 1961. Chromosome numbers in some Japanese species of *Cacalia* and the allied genera. *Acta Phytotax. Geobot.* 19 : 18 - 19.
- KOYAMA, H. 1967. Taxonomic studies on the tribe Senecioneae of Eastern Asia I. General part. *Mem. Coll. Sci. Univ. Kyoto, Series B.* 33 : 183 - 209.
- TAKESHITA, M. 1961. Cytological studies on *Cacalia* and its related genera. I. The chromosome number of three species and one variety of *Cacalia* and one species of *Miricacalia*. *Jap. Journ. Genet.* 36: 217 - 220.

Genus **Cacalia**

Cacalia was fairly heterogeneous, when LINNAEUS originally described it.

There are differences of opinion among investigators as to the selection of the type species of *Cacalia*. CASSINI created a new genus *Adenostyles* for a group including *Cacalia alpina* L. in 1816. In Prodromus VI, De CANDOLLE placed two Linnean species: *C. hastata* and *C. suaveolens* in *Cacalia* Sect. *Eucacalia*. In a supplement to the International rules (1935), *Cacalia atriplicifolia* was selected by HITCHCOCK and GREEN as the type of this genus. Considering the generic description by LINNAEUS, KITAMURA (1938) designated *C. hastata* as the type. In Flora URSS XXVI, POJARKOVA also designated *C. hastata* as the type, though she (1960) had considered *C. atriplicifolia* as type of this genus. Recently, R. W. PIPPEN in Contr. U. S. National Heab. XXXVI: 377, considered *Cacalia alpina* L. (*Adenostyles alpina*) as the type of *Cacalia*. As mentioned above, since CASSINI and De CANDOLLE, *Cacalia* excluding *Adenostyles alpina* has been used generally in floras and monographs. Thus, *C. hastata* may better be recognized as the type species of the present genus.

Cacalia L. Gen. Pl. II: 362 (1754) Type: *C. hastata*; KITAM. Comp. Jap. III: 202 (1942); SHINNERS in Field Laboratory, 18: 79 (1950); HARA, Enum. Sperm. Jap. II: 146 (1952); POJARKOVA, Not. System. XX: 370 (1960), Fl. URSS, XXVI: 683 (1961); KOYAMA in Acta Phytotax. Geobot. 20: 172 (1962); OHWI, Fl. Jap. Eng. ed. 882 (1965).

Perennial herbs. Leaves alternate, caudine, several or a few (usually two) with long petioles, hastate with pinnate venation, reniformcordate with triple-ribbed venation, palmate with palmate venation, basifix or rarely peltate. Inflorescences compound corymbose or panicle, homogamous. Heads all discoid, with bracteoles. Florets hermaphrodite, fertile, tubular, 5-lobed at apex, white or pale-yellow. Anther bases obtuse or tailed. All cells of upper part of filament nearly same in size. Style branches long, truncate, hairy at tip, and beneath for their entire length. Achenes cylindric, tapered off at both ends, glabrous, with soft, white or tawny pappus.

The present genus is widely distributed in Asia and America. About 60 species are known from Asia. All species of Japan, a few of China and some of America are cytologically examined by some investigators. In the following list, they are arranged in alphabetical order. The species marked with asterisks do not occur in our region.

Species	n	2n	Investigator
<i>Cacalia adenostyloides</i>		60	KOYAMA 1961, 1966a; ARANO 1964a.
<i>Cacalia amagiensis</i>		58	KOYAMA 1961.
<i>Cacalia atriplicifolia</i> *	25		JACKSON 1962 in Cave 1963; AFZELIUS 1967.
<i>Cacalia auriculata</i>		60	KOYAMA 1961, 1966; ARANO 1964a.
	60	120	KOYAMA 1966.
<i>Cacalia decomposita</i> *	30		ORNDUFF et al. 1963.
<i>Cacalia delphinifolia</i>	26	52	ARANO 1964a.
		52	KOYAMA 1961; TAKESHITA 1961.
<i>Cacalia divaricata</i> *		50	KOYAMA not yet published.

<i>Cacalia farfaraefolia</i>		60	TAKESHITA 1961 ; ARANO 1964a.
<i>Cacalia hastata</i>	30		AFZELIUS 1949.
	30	60	ARANO 1964a ; KOYAMA 1968.
		60	KOYAMA 1961 ; ZHUKOVA 1964 in CAVE 1965.
<i>Cacalia kiusiana</i>		52	KOYAMA 1961.
<i>Cacalia maximowicziana</i>	30	60	KOYAMA 1968.
"		60	ARANO 1964a.
(under <i>C. hastata</i>)			
<i>Cacalia muhlenbergii*</i>	25		AFZELIUS 1924.
(under <i>C. reniformis</i>)			
<i>Cacalia nikomontana</i>	30	60	KOYAMA 1961.
		60	ARANO 1964a.
<i>Cacalia nipponica</i>		60	KOYAMA 1961.
<i>Cacalia nokoensis</i>		60	KOYAMA 1964.
<i>Cacalia peltifolia</i>		52	KOYAMA 1961.
<i>Cacalia peltata*</i>	30		BEAMAN & T. 1962.
<i>Cacalia roborskii</i>	30		AFZELIUS 1949.
<i>Cacalia shikokiana</i>		60	KOYAMA 1961.
<i>Cacalia sinuata*</i>	30		TURNER et al. 1962 ; De JONG & L. 1963 in Cave 1964.
<i>Cacalia suaveolens*</i>	20		AFZELIUS 1924.
<i>Cacalia sulcata*</i>		50	KOYAMA 1966a.
<i>Cacalia tebakoensis</i>		52	KOYAMA 1961 ; ARANO 1964a.
<i>Cacalia cf. tussilaginoides*</i> ca. 25			TURNER et al. 1962.
<i>Cacalia yakushimensis</i>		60	KOYAMA 1968.
<i>Cacalia yatabei</i>		60	TAKESHITA 1961 ; ARANO 1964a.

Two types of chromosome number are observed in the present genus. One is 52 chromosomes and the other 60 chromosomes in diploid condition. 52 chromosomes may be derived from the basic number $X_e = 12$ and 60 chromosomes may be derived from $X_b = 30$, as interpreted in the evolutionary trends of the chromosome numbers in the general part of this series. The basic numbers of both X_b and X_e is considered not to be easily changeable from one to the other. In addition, each section of the allied genus *Senesio* has one type of basic number as shown in Table 2 of the general part. Thus, the present genus may better be revised from the standpoint of the chromosomal accounts as attempted in my previous paper (1962).

Considering the basic numbers of the chromosomes with the other taxonomic features, eastern Asiatic *Cacalia* seems to be classified into five sections indicated by the following characters.

- A. Petiolar bases completely surround the stem and shortly sheathing as in *Ligularia*. Sect. **Vaginales**.
- A. Petiolar bases slightly or not sheathing. B.
- B. Cauline leaves 2 (-3) in number. Sect. **Taimingasa**.

- B. Cauline leaves more than 3 (-2) in number. C.
 C. Leaves peltate. Sect. **Hirsutae**.
 C. Leaves basifixied. D.
 D. Lamina palmate, with palmate venation. Sect. **Delphiniifoliae**.
 D. Lamina not palmate, with triple-ribbed or rarely pinnate venation.
 Sect. **Cacalia**.

Sect. **Vaginales** H. KOYAMA sect. nov.

Folia radicalia inferioraque basi caulem compliter amplectentia breviter vaginata. Styli rami apice truncati penicillati, capitula discoidea.

This section is resemble to *Ligularia*, though it is distinguished from *Ligularia* by the form of stigma and smaller discoid heads.

Several species are described from Himalayas and southern China, though the materials are too scanty at hand to study the specific discrimination of these taxa in details.

Cacalia mortoni (CLARKE) KITAM. ex KOYAMA comb. nov.— *Senecio mortoni* CLARKE, Comp. Ind. 208 (1876) Type from Sikkim.

BHUTAN Between Gosa and Temji, *S. Nakao* 433 (KYO); Chiley La, between Paro and Ha Dzong, *S. Nakao* 54 (KYO); Ha La - Kyu La, *S. Nakao* 728 (KYO).

Judging from the descriptions and the figures given in the literatures, the following species are referable to this section, though the herbarium specimens have not been examined actually for every species.

Cacalia konkalingensis (HAND.-MZT.) H. KOYAMA comb. nov.— *Ligularia konkalingensis* HAND.-MZT. in ENGLER Bot. Jahrbuch. 69 : 112 (1939) Type from Prov. SW-Szechuan, China.

Cacalia macrodonta (LING) H. KOYAMA comb. nov.— *Ligularia macrodonta* LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5 : 2, Pl. II (1937) Type from Prov. Kokonor, China.

Cacalia potanini (C. WINKLER) MATTF. ex RHEDER & KOBUSKI in Journ. Arn. Arb. 14 : 39 (1933).— *Senecio potanini* C. WINKLER in Acta Hort. Petrop. 13 : 5 (1893) Type from Prov. SW-Kansu, China.

Cacalia tangutica (MAXIM.) HAND.-MZT. in Acta Hort. Gotoburg. 12 : 300 (1938).— *Senecio tanguticus* MAXIM. in Bull. Acad. Petersb. 27 : 486 (1881) Type from Prov. Kansu, China.

Sect. **Taimingasa** KITAM. in Acta Phytotax. Geobot. 7 : 249 (1938), Comp. Jap. III : 221 (1942) pro parte; KOYAMA in Acta Phytotax. Geobot. 20 : 172 (1962), in Mem. Nat. Sci. Mus. Tokyo, 1 : 75 (1968).

Cacalia peltifolia is excluded from this section, because it has unique taxonomic characters than the members of this section, i. e. peltation of leaves, repent but short and thick rhizomes, and minute hairs consisting of quite different cellular constituent from those of the other species of this section (KOYAMA 1968). Here, *C. yatabei* is designated as the type of this section.

Key to the species

- A. Leaves reniform, margin toothed, not lobed. **C. amagiensis**.

- A. Leaves otherwise. B.
- B. Petioles without wing. C. *yatabei*.
- B. Petioles with wing. C.
- C. Leaves largely toothed, not lobed. C. *firma*.
- C. Leaves palmately lobed. C. *pseudotaimingasa*.

Cacalia amagiensis KITAM. Comp. Nov. Jap. I: 23 (1931), Comp. Jap. III: 222 (1942) Type: Honshu Pref. Shizuoka: Nekko-toge in Mt. Amagi, J. Sugimoto (Holotype in KYO); HARA, Enum. Sperm. Jap. II: 147 (1952); OHWI, Fl. Jap. Eng. ed. 884 (1965).

Endemic to Japan, restricted to Idzu Peninsula of Honshu; on grassy slope at the edge of forest, 600 - 1000 m alt.

Cacalia yatabei MATSUM. et KOIDZ. in Bot. Mag. Tokyo, 24: 152 (1910) Type: Honshu Pref. Tochigi: Utanohama, Nikko, J. Matsumura (Holotype in TI); KITAM. Comp. Jap. III: 223 (1942); HARA, Enum. Sperm. Jap. II: 152 (1952); OHWI, Fl. Jap. Eng. ed. 885 (1965); KOYAMA in Mem. Nat. Sci. Mus. Tokyo, 1: 75 (1968).

Endemic to Japan, ranging mainly along the Pacific coast of Japan; on rich soil in mountain forest.

Two varieties are recognizable in this species.

Var. *yatabei*—KOYAMA l. c.

Miricacalia yatabei (MATSUM. et KOIDZ.) NAKAI in Journ. Jap. Bot. 14: 641 (1938).

Five florets and 5 - (6) involucral scales per head.

This variety is not known from Kyushu.

Var. *occidentalis* F. MAEKAWA ex KITAM. in Acta Phytotax. Geobot. 7: 250 (1938), Comp. Jap. III: 224 (1942); HARA, Enum. Sperm. Jap. II: 152 (1952); OHWI, Fl. Jap. Eng. ed. 885 (1965); KOYAMA in Mem. Nat. Sci. Mus. Tokyo, 1: 75 (1968). — *Miricacalia maekawae* NAKAI in Journ. Jap. Bot. 14: 642 (1938) Type: Honshu Pref. Nara: Mt. Ohdaigahara-yama, S. Sakaguchi (Holotype in TI).

Three florets and 3 - (4) involucral scales per head.

This variety does not occur in northern Honshu, where var. *yatabei* distributes.

Cacalia firma KOMAROV in Acta Hort. Petrop. 18: 420 (1900) Type from Manchuria; KITAM. Comp. Jap. III: 225 (1942); KOYAMA in Mem. Nat. Sci. Mus. Tokyo, 1: 75 (1968).

Distribution: northern Korea and Manchuria.

Cacalia pseudotaimingasa NAKAI in Bot. Mag. Tokyo, 29: 8 (1915) Type: Korea Prov. Keinan: Mt. Chiizan, T. Mori (Lectotype in TI); KITAM. Comp. Jap. III: 224 (1942); KOYAMA in Mem. Nat. Sci. Mus. Tokyo, 1: 75 (1968).

Endemic to Korea.

This species resembles *C. yatabei*, though it differs distinctly from *C. yatabei* in the petioles with wings and the palmately lobed leaves.

Sect. **Hirsutae** H. KOYAMA sect. nov.

Folia peltata palmatifida, supra atroviridia crispato-puberula subtus secus venos sparse puberula. Rhizoma breviter ramosa. Chromosomata $2n = 52$.

Cacalia peltifolia is the representative of this section and is known only from Japan. None of the allied species is known from China. As mentioned in Sect. *Taimingasa*, *C. peltifolia* is characterized by unique features different from the members of Sect. *Taimingasa*. In addition, the chromosome numbers of this species are 52 in diploid condition. Thus, the present species can better be placed in separate section.

Cacalia peltifolia MAKINO in Journ. Jap. Bot. 5: 27 (1928) Type from Japan; KITAM. Comp. Jap. III: 222 (1942); HARA, Enum. Sperm. Jap. II: 151 (1952); KOYAMA in Acta Phytotax. Geobot. 20: 172 (1962), in Mem. Nat. Sci. Mus. Tokyo, 1: 74 (1968); OHWI, Fl. Jap. Eng. ed. 884 (1965).

Endemic to Honshu, restricted to Japan sea side region; on moist sandy ground by stream in mountain forest, 300 - 700 m alt.

As described in my previous paper (1962), the young leaves of this species are similar to the leaves of *C. delphinifolia*.



Fig. 6. Range of *Cacalia peltifolia*.

Sect. ***Delphiniifoliae*** H. KOYAMA sect. nov.

Folia caulina numerosa, palmatifida. Chromosomata $2n = 52$.

This section is characterized by its venation of leaf and has 52 chromosomes in indiploid condition.

- A. Leaves palmately 5-lobed, the lobes deltoid; heads with small bracteoles at base; pappus reddish. *C. kiusiana*.
- A. Leaves palmately 5 to 7-lobed, the lobes oblong; heads without bracteoles at base; pappus white. B.
- B. Plants stoloniferous; leaves with raised veinlets; involucres 5 - 6 mm in

- length ; corolla lobes without papilla at apex. *C. tebakoensis*.
 B. Plants not stoloniferous ; leaves with scarcely raised veinlets ; involucres
 9 - 10 mm in length ; corolla lobes with long papillae at apex.
 *C. delphinifolia*.

Cacalia kiusiana MAKINO in Bot. Mag. Tokyo, 24 : 228 (1910) Type : Kyushu
 Pref. Kagoshima : Mt. Eboshidake, *N. Nakajima* (Lectotype in TI); KITAM.
 Comp. Jap. III : 220 (1942); HARA, Enum. Sperm. Jap. II : 150 (1952); OHWI,
 Fl. Jap. Eng. ed. 884 (1965).

Endemic to Kyushu, Japan ; on rich soil in mountain forest, 600 - 1000 m
 alt.

The present species was described by MAKINO on the specimens collected
 from Japan, Kyushu Pref. Kagoshima : Tarumidzu, *Y. Nakao* (in KYO) and
 Mt. Eboshidake, *N. Nakajima* (in TI). The type specimen has not yet been
 designated, and NAKAJIMA's specimen is here designated as the type.

Cacalia tebakoensis (MAKINO) MAKINO in Journ. Jap. Bot. 2 : 21 (1922);
 KITAM. Comp. Jap. III : 205 (1942); HARA, Enum. Sperm. Jap. II : 151 (1952);
 OHWI, Fl. Jap. Eng. ed. 883 (1965); KOYAMA in Bull. Nat. Sci. Mus. Tokyo,
 11 : 173 (1968). — *Cacalia delphinifolia* var. *tebakoensis* MAKINO in Bot. Mag.
 Tokyo, 24 : 230 (1910) Type : Shikoku Pref. Kochi : Mt. Tebako, *R. Yatabe*
 (Holotype in TI).

Endemic to Japan, restricted to so called Sohayaki region ; on humus in
 light forest of mountain, 800 - 1500 m alt.

The present species has a close resemblance to *C. delphinifolia*, though it
 is clearly distinguished from *C. delphinifolia* in the prominent leaf veins on both
 surfaces, the shorter involucres and in the papillae being absent or very small at
 the apex of corolla lobes.

Cacalia delphinifolia SIEB. et ZUCC. in Abh. Acad. Muench. IV-3 : 190
 (1846) Type from Japan ; KITAM. Comp. Jap. III : 205 (1942); HARA, Enum.
 Sperm. Jap. II : 148 (1952); OHWI, Fl. Jap. Eng. ed. 883 (1965).

Endemic to Japan ; on humus in light forest of mountain regions, 400 -
 1000 m alt.

In most of the specimens, leaves are cordate at the base and palmate, 5 to
 11 lobes ; lobes lanceolate, acuminate, irregularly inciso-dentate. In the speci-
 men collected from Toshima Island, Prov. Idzu, by Y. SUZUKI (in TI), how-
 ever, the lobes are deeply dentate and the base of leaves are not cordate.

Following Chinese species may be referred to this section.

Cacalia delphiniphylla (Lév.) HAND.-MZT. in Notizbl. Bot. Gart. Berlin,
 13 : 635 (1937). — *Senecio delphiniphyllus* Lév. in Bull. Geogr. Bot. 25 : 18
 (1915) Type from Prov. Yunnan.

Cacalia sinica LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5 : 7 (1937)
 Type from Prov. Honan.

Considering the features and descriptions of these species, they seem to be
 related to *C. delphinifolia*.

Sect. ***Cacalia***. — Sect. *Eucacalia* DC. Prod. VI : 327 (1837); KITAM.

Comp. Jap. III : 203 (1942) pro parte.

The present section comprises more species than the other sections and is divided into four series by the following key characters.

- A. Involucres 2 mm in length. Series **Trilobae**.
- A. Involucres 4 mm or longer in length. B.
- B. Leaves arachnoid beneath. C.
- B. Leaves not arachnoid beneath. Series **Cacalia**.
- C. Leaves with triple-ribbed venation, anther base long tailed. Series **Monanthes**.
- C. Leaves with pinnate venation, anther base auricled, not long tailed. Series **Pinnatae**.

Series Trilobae H. KOYAMA ser. nov.

Involucrum 2 mm longum. Involucri squamae 4, flosculi 2. Folia trifida petiolis basi amplexicaulibus auriculatis.

Only one species is known from Himalayas. The present series may be related to Sect. *Delphinifoliae*, since the venation is near to that of Sect. *Delphinifoliae*.

Cacalia chenopodifolia (DC.) KITAM. ex KOYAMA comb. nov. — *Senecio chenopodifolius* DC. Prod. VI : 364 (1837) Type from Gossain-Kunde in Nepal.

Distribution : eastern Himalayas (Nepal and Bhutan).

BHUTAN Between Tnaga and Parshong, S. Nakao 591 (KYO).

As noted by De CANDOLLE, the style branches of this species are similar to those in the genus *Senecio*. Leaves of this species have not trinerved venation but rather palmate one. Thus, the present species may stand between Sect. *Delphinifoliae* and Sect. *Cacalia*.

Series **Monanthes** KITAM. in Acta Phytotax. Geobot. 7 : 248 (1938), Comp. Jap. III : 221 (1942) emend H. KOYAMA.

Folia dense arachnoideos. Antherae basi sagittatae, auriculis elongatis. Flosculi flavi.

This series is characterized by its pale-yellow corolla, the leaves arachnoid beneath and usually bearing the bulbiles at the base of petioles. Only one species occurs in Japan, but perhaps twenty species in China. Considering their characters and many species occurring in China, the present series may better be raised to separate section.

Following three species are distinguished by the key characters.

- A. Involucral scales 2 and floret 1 in a head. C. **monantha**.
- A. Involucral scales 5 and florets 5 - 7 in a head. B.
- B. Leaves orbiculate-reniform, broadly cordate at base. C. **hwangshanica**.
- B. Leaves hastate-reniform, narrowly cordate at base. C. **farfaraefolia**.

Cacalia monantha (DIELS) HAYATA, Icon. Pl. Formos. VIII : 66 (1919); KITAM. Comp. Jap. III : 221 (1942). — *Senecio monanthus* DIELS in ENGLER Bot. Jahrb. 29 : 621 (1901) Type from Prov. Paohsien, China.

Distribution : southern China and Taiwan.

Considering the small numbers of floret and involucral scales in this species,

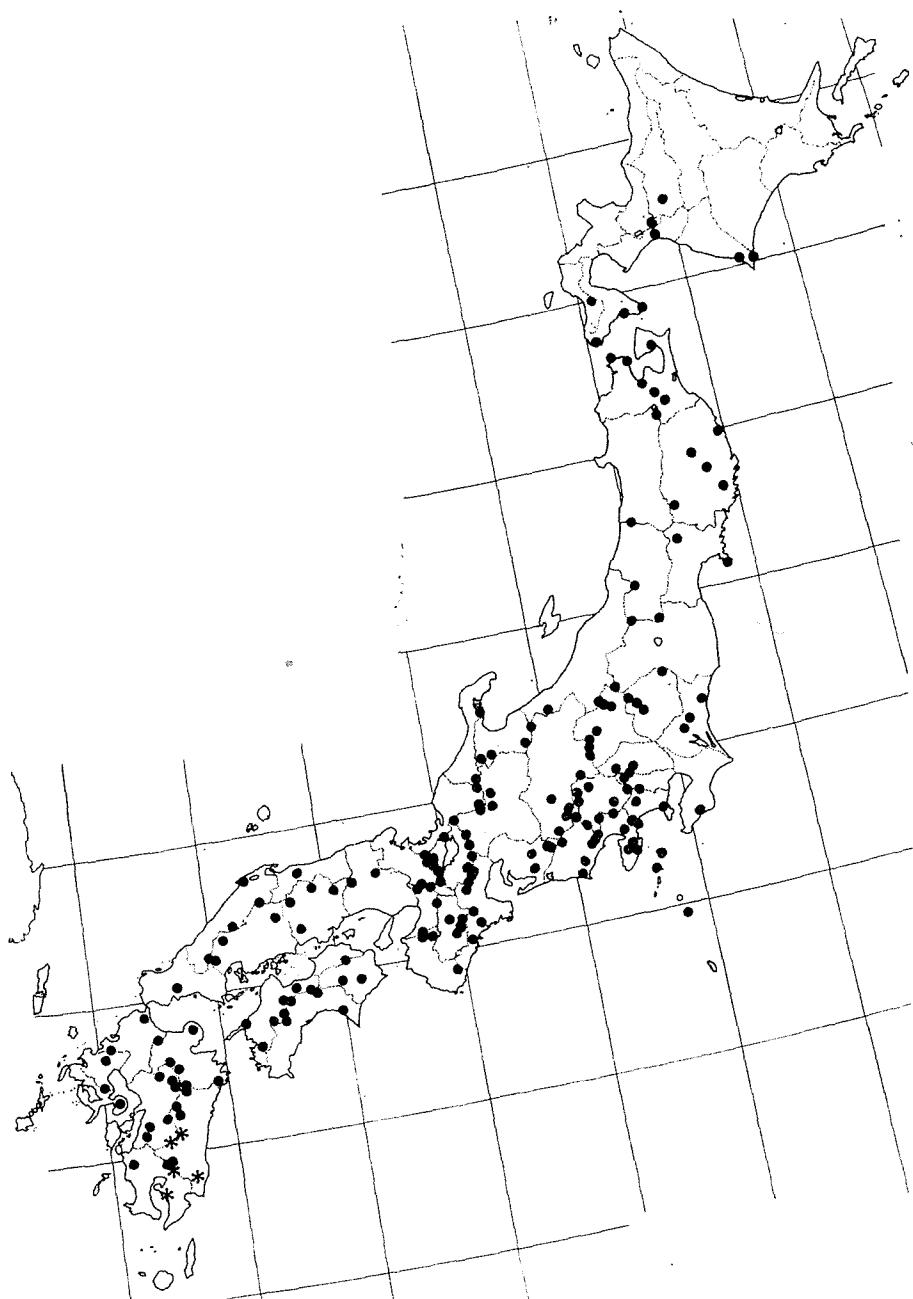


Fig. 7. Ranges of *Cacalia delphiniifolia* (●) and *C. kiusiana* (*).

KITAMURA placed the present species in a separate series. In this species, indeed, the floret is only one and involucral scales are 2 or 3 in a head. One floret in a head is the character unique in our tribe. But the present species has, at least apparently, similar features to *C. farfaraefolia*. Some taxonomic characters of this species, i. e. the form of anther base, arac hnoidhairs on leaf beneath, bulbiles at axil and leaf shape, are also observed in the allied *C. farfaraefolia*. Thus, this species may better be referred to the present series, though the colour of corolla is not observed as to the living materials of this species.

Cacalia hwangshanica LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5 : 11 (1937) Type from Prov. Anwei, China.

TAIWAN Prov. Taichu : Mt. Tsugitaka, *T. Hosokawa* 2330 (TAI); Smutta, prope Mt. Kotenzan, *T. Hosokawa* 2259 (TAI).

This is the first record of this species from Taiwan.

Distribution: eastern China and Taiwan.

Cacalia farfaraefolia SIEB. et ZUCC. in Abh. Acad. Muench. IV-3 : 190 (1846) Type from Japan; KITAM. Comp. Jap. III : 207 (1942) incl. syn.; HARA, Enum. Sperm. Jap. II : 148 (1952); OHWI, Fl. Jap. Eng. ed. 883 (1965).

Three varieties are recognized by KITAMURA.

Var. ***farfaraefolia***

This variety distributes mainly in western Japan and sometimes occurs in northern Honshu.

Var. ***bulbifera*** (MAXIM.) KITAM. in Acta Phytotax. Geobot. 7 : 240 (1938), Comp. Jap. III : 208 (1942); HARA, Enum. Sperm. Jap. II : 148 (1952); OHWI, Fl. Jap. Eng. ed. 883 (1965). — *Senecio bulbifera* MAXIM. in Mél. Biol. 9 : 295 (1874) Type from Mt. Iwate in northern Honshu.

This variety is characterized by having densely cobwebby hairs on leaf beneath and distributes from central Honshu to southern Hokkaido.

Var. ***acerina*** (MAKINO) KITAM. Comp. Jap. III : 209 (1942); HARA, Enum. Sperm. Jap. II : 148 (1952); OHWI, Fl. Jap. Eng. ed. 883 (1965). — *Cacalia bulbifera* var. *acerina* MAKINO in Bot. Mag. Tokyo, 19 : 154 (1905) Type from Mt. Tara, Kyushu.

This variety occurs in the Pacific side of western Japan and differs from the other varieties in having leaves being palmately cleft.

Cacalia pentaloba HAND.-MZT. in Acta Hort. Gotoburg. 12 : 298 (1938). — *Prenanthes quinqueloba* DC. Prod. VII : 195 (1838) Type from Gossain-Than in Nepal. — *Senecio quinquelobus* (DC.) Hook. f. Fl. Brit. Ind. III : 353 (1881). — *Cacalia quinqueloba* (DC.) KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 249 (1955), non THUNB. (1800).

NEPAL Tolo Gompa Khola, *S. Nakao* (KYO). E-NEPAL Near Deoma, *K. Nishioka* 1045 (KYO). BHUTAN Chiley La, between Paro and Ha Dzong, *S. Nakao* 57 (KYO); Ha La - Kyu La, *S. Nakao* 810 (KYO).

Distribution: Himalayas, from Garwhal to Bhutan.

Further study is required as to the taxonomical position of this species,

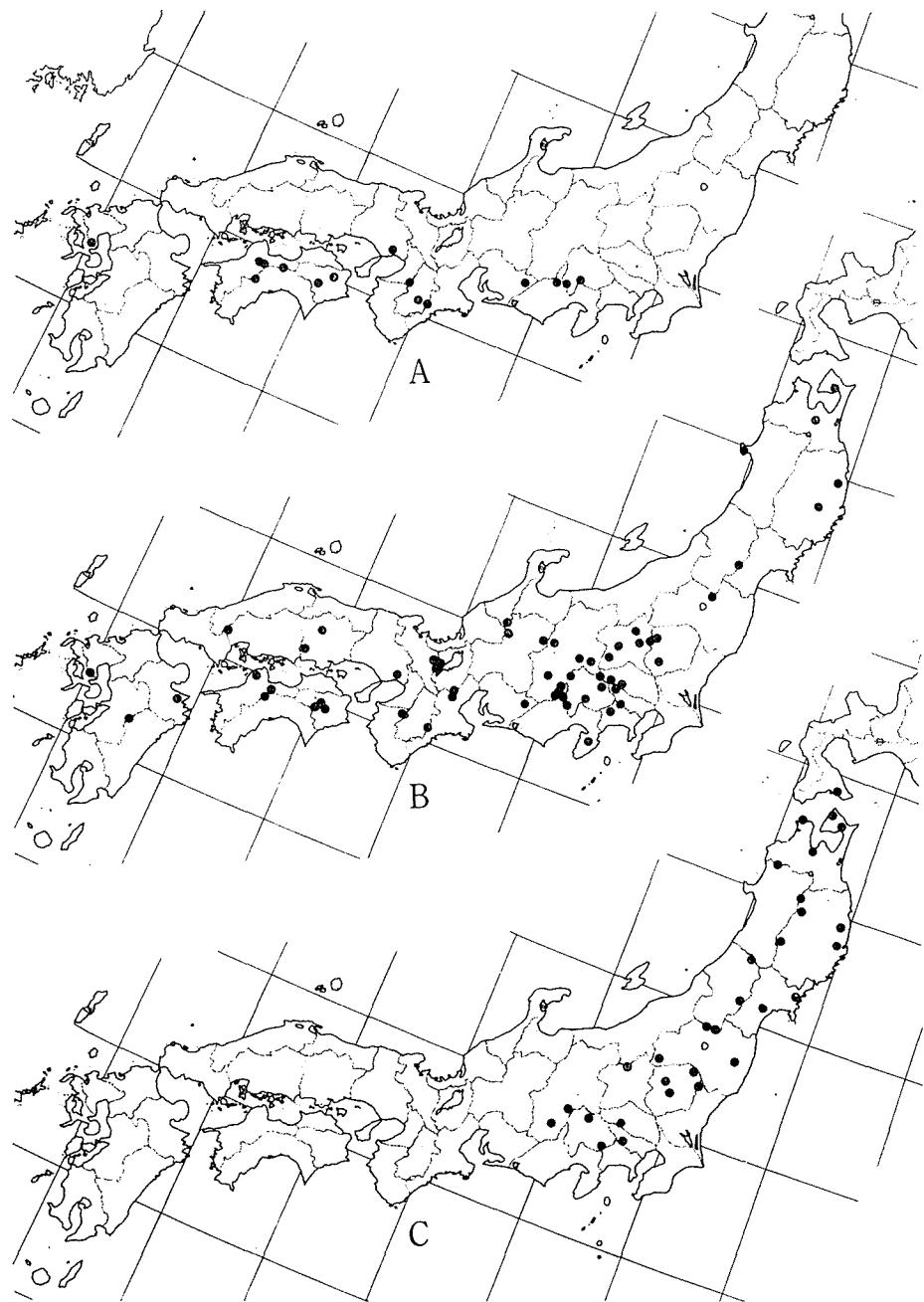


Fig. 8. Ranges of the infraspecific taxa of *Cacalia farfaraefolia*.
A : var. *acerina*. B : var. *farfaraefolia*. C : var. *bulbifera*.

though the present species is tentatively placed in this series.

The following Chinese or Himalayan species may be referred to the present series.

Cacalia ambigua LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5: 13 (1937) Type from Prov. Shensi.

Cacalia bulbiferooides HAND.-MZT. Symb. Sin. Pt. VII: 1131 (1936) Type from Prov. W-Hupei.

Cacalia dasythyrsa HAND.-MZT. in Acta Hort. Gotoburg. 12: 296 (1938) Type from Prov. Shansi.

Cacalia hupehensis HAND.-MZT. Symb. Sin. Pt. VII: 1131 (1936) Type from Prov. W-Hupei.

Cacalia koualapensis (FRANCH.) HAND.-MZT. in KARST. et SCHENK Vegetbild. 22: 9 (1932). — *Senecio koualapensis* FRANCH. in MOROT Journ. de Bot. 8: 356 (1894) Type from Prov. Yunnan.

Cacalia leucocephala (FRANCH.) HAND.-MZT. in Notizbl. Bot. Gart. Berlin, 13: 636 (1937). — *Senecio leucocephalus* FRANCH. in MOROT Journ. de Bot. 8: 360 (1894) Type from Prov. Szechuan.

Cacalia palmatisecta (JEFFR.) HAND.-MZT. in KARST. et SCHENCK Vegetbild. 22: 9 (1932). — *Senecio palmatisectus* JEFFR. in Not. Bot. Gard. Edinb. 9: 128 (1916) Type from Prov. Yunnan.

Cacalia phyllolepis (FRANCH.) HAND.-MZT. in Notizbl. Bot. Gart. Berlin, 13: 636 (1937). — *Senecio phyllolepis* FRANCH. in MOROT Journ. de Bot. 8: 360 (1894) Type from Prov. Szechuan.

Cacalia roborowskii (MAXIM.) LING in Contr. Inst. Bot. Nat. Acad. Peiping, 2: 529 (1934). — *Senecio roborowskii* MAXIM. in Bull. Acad. Petersb. 27: 487 (1881) Type from Prov. Kansu.

Cacalia rockiana HAND.-MZT. in Notizbl. Bot. Gart. Berlin, 13: 634 (1937) Type from Prov. NW-Yunnan.

Cacalia rufipilis (FRANCH.) LING in Contr. Inst. Bot. Nat. Acad. Peiping, 5: 10 (1937). — *Senecio rufipilis* FRANCH. in MOROT Journ. de Bot. 8: 359 (1894) Type from Prov. Szechuan.

Cacalia souliei (FRANCH.) HAND.-MZT. in Notizbl. Bot. Gart. Berlin, 13: 635 (1937). — *Senecio souliei* FRANCH. in Bull. Soc. Philom. Paris, Ser. VIII, 3: 165 (1891) Type from Prov. Sikang.

Series *Cacalia*. — Series *Candidae* KITAM. Comp. Jap. III: 203 (1942) pro parte.

The present series comprises about fifteen species and distributes widely in Asia and North America.

Key to the species

- A. Stem angular; inflorescences narrow panicle. B.
- A. Stem terete; inflorescences otherwise. C.
- B. Cauline leaves 3 - 4 in number; involucral scales 3 in number.

- *C. adenostyloides*.
 B. Cauline leaves more than 5 in number ; involucral scales 5 in number.
 *C. auriculata*.
 C. Florets 15 - 38 in a head. D.
 C. Florets less than 15 in a head. E.
 D. Involucral scales 7 - 8 per head. *C. rubescens*.
 D. Involucral scales 12 per head. *C. matsudae*.
 E. Involucral scales 5 ; inflorescences corymbose. F.
 E. Involucral scales more than 5 ; inflorescences corymbose or otherwise. ... G.
 F. Leaves reniform, 5 - 18 cm in length, 9 - 27 in width, mucronate-toothed.
 *C. nikomontana*.
 F. Leaves 3.5 - 4.5 cm in length, 5 - 6.5 cm in width, coarsely incised.
 *C. shikokiana*.
 G. Inflorescences corymbose. H.
 G. Inflorescences otherwise. J.
 H. Leaves depressed-reniform, incised-toothed, long-caudate. ... *C. nipponica*.
 H. Leaves reniform. I.
 I. Involucral scales 5 to 6 or rarely 7 or 8 in a head ; endemic to Honshu.
 *C. maximowicziana*.
 I. Involucral scales 7 or rarely 6 in a head; endemic to Yakushima Island.
 *C. yakushimensis*.
 J. Plants with bulbils at the base of petioles. *C. nokoensis*.
 J. Plants without bulbil. *C. hastata*.

Cacalia adenostyloides (FR. et SAV.) MATSUM. Shokubutsu Mei-i, no. 580 (1895); KITAM. Comp. Jap. III: 204 (1942); HARA, Enum. Sperm. Jap. II: 146 (1952); OHWI, Fl. Jap. Eng. ed. 882 (1965). — *Senecio adenostyloides* FR. et SAV. ex MAXIM. in Mél. Biol. 9: 297 (1874) Type from Japan.

Endemic to Japan ; on humus in light forest of subalpine regions.

According to the records in Honshu and Shikoku, the distribution pattern of this species is closely connected with the northern conifer forest. The stems are usually green, but we occasionally find the reddish-purple one.

Cacalia auriculata DC. Prod. VI: 329 (1837) Type from Dauria ; KITAM. Comp. Jap. III: 209 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II: 147 (1952); POJARKOVA, Fl. URSS, XXVI: 694 (1961); KOYAMA in Acta Phytotax. Geobot. 22: 11 (1966).

This variable species are splitted by POJARKOVA into three 'species', though KITAMURA considered them as infra-specific taxa. As reported in my paper concerning to the length of involucres of this species, this character is much variable. In addition, the groups taken up by POJARKOVA are all considered as the extreme cases of the variation. Thus, they can be treated as the following.

Var. **auriculata**

Distribution : Saghalien, Manshuria, North Korea and Siberia.

Involucres 5 - 6 mm in length ; stem slender, less than 50 cm in height;

leaves obovate-reniform.

Var. **kamtschatica** MATSUM. Shokubutsu Mei-i, 56 (1895); KITAM. Comp. Jap. III : 210 (1942); HARA, Enum. Sperm. Jap. II : 147 (1952); OHWI, Fl. Jap. Eng. ed. 883 (1965); KOYAMA in Acta Phytotax. Geobot. 22 : 11 (1966). — *Senecio dahuricus* β . *kamtschaticus* MAXIM. in Bull. Acad. St.-Pet. 19 : 486 (1874) Type from Kamtchatka.

Cacalia kamtschatica (MAXIM.) KUDO in Journ. Coll. Agric. Hokkaido Univ. 12 : 60 (1923); POJARKOVA, Fl. URSS, XXVI : 695 (1961).

Cacalia praetermispa (POJARKOVA) POJARKOVA, Fl. URSS, XXVI : 692 (1961). — *Hasteola praetermispa* POJARKOVA, Not. Syst. XX : 386 (1960) Type from Ussuri.

Distribution : northern Japan, Kuriles, eastern Manshuria, Korea, Saghalien and Kamtchatka.

This variety consists of a diploid race with the somatic number of 60 chromosomes and a tetraploid race with the somatic number of 120 chromosomes. Concerning to the differences between diploid and tetraploid races of this variety, however, no remarks can be given from the herbarium works.

Var. **matsumurana** NAKAI in Bot. Mag. Tokyo, 23 : 187 (1909) Type: Korea, Prov. Kogen : Mt. Kongo, *T. Uchiyama* (Holotype in TI); KITAM. Comp. Jap. III : 212 (1942).

Distribution : southern Korea.

In this variety, the petiolar base does not develop to form an auricle.

Var. **bulbifera** KOIDZ. in Bot. Mag. Tokyo, 31 : 137 (1917) Type : Hokkaido Prov. Ishikari : Mt. Yubari, *H. Y.* (Holotype in SAP); KITAM. Comp. Jap. III : 212 (1942); HARA, Enum. Sperm. Jap. II : 147 (1952); OHWI, Fl. Jap. Eng. ed. 883 (1965).

Endemic to Hokkaido.

The present variety is characterized by having a bulbil at the base of petiole.

Cacalia rubescens (S. MOORE) MATSUDA in Bot. Mag. Tokyo, 32: p. (28) (1918) excl. specimen ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19: 8 (1966). — *Senecio rubescens* S. MOORE in Journ. Bot. 13 : 228 (1875) Type from Kiukiang, Prov. Kiangsi, China.

CHINA Prov. Kiangsi : Lushan, *M. Migo* 68-1, 68-2 (KYO); ibidem, *T. Liu* (KYO).

Cacalia matsudae KITAM. in Journ. Jap. Bot. 20 : 196 (1944) Type : China, Prov. Chekiang: Mt. Hsi-tienmu-shan, *M. Migo* 67 (Holotype in KYO).

Cacalia rubescens MATSUDA in Bot. Mag. Tokyo, 32: p. (28) (1918) pro parte, non (S. MOORE) MATSUDA.

CHINA Prov. Chekiang : Mt. Hsi-tienmu-shan, *M. Migo* 67 (KYO).

This species is closely related to *C. rubescens*, though it differs from *C. rubescens* in the numbers of florets and involucral scales per head.

Cacalia nikomontana MATSUM. in Bot. Mag. Tokyo, 13 : 84 (1899) Type : Honshu, Pref. Tchigi : Mt. Shirane, Nikko, *J. Matsumura* (Holotype in TI); KITAM. Comp. Jap. III : 212 (1942); HARA, Enum. Sperm. Jap. II : 151 (1952);

OHWI, Fl. Jap. Eng. ed. 883 (1965); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968).

Endemic to Honshu ; on grassy slope in light forest of mountains of Japan sea side.

Cacalia shikokiana MAKINO in Bot. Mag. Tokyo, 12 : 80 (1898); KITAM. Comp. Jap. III : 213 (1942); HARA, Enum. Sperm. Jap. II : 151 (1952); OHWI, Fl. Jap. Eng. ed. 883 (1965); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968). — *Senecio farfaraefolius* var. *humilis* MAKINO in Bot. Mag. Tokyo, 7 : 104 (1893) Type : Shikoku, Pref. Kochi : Mt. Kuishi, *T. Makino* (Lectotype in TI).

Endemic to Japan, restricted to Shikoku and Prov. Kii of Honshu ; on humus in light forest in mountain regions.

Cacalia nipponica MIQ. in Ann. Mus. Bot. Lugd.-Bat. 2 : 181 (1866) Type : Japan, Nippon : Kamiyama, *Pierrot* (Isotype in KYO); KITAM. Comp. Jap. III : 214 (1942); HARA, Enum. Sperm. Jap. II : 151 (1952); OHWI, Fl. Jap. Eng. ed. 884 (1965); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968).

Endemic to Kyushu ; on grassy slope in mountain regions, 700 - 1200 m alt.

Type locality, Nippon : Kamiyama, has not yet been clarified. The present species has close affinity to *C. shikokiana*, though it differs from *C. shikokiana* in the following characters, i. e. plant larger, 8 involucral scales and 13 florets in a head, middle leaves rather wide reniform, with 3 - 5 large teeth apical lobe acuminate and lateral lobes usually bilobed and lanceolate.

Cacalia maximowicziana NAKAI et F. MAEKAWA ex HARA in Journ. Jap. Bot. 10 : 432 (1934); MAEKAWA in NAKAI Icon. Pl. As.-Or. I : 8 (1935), Seibutsu no Hen-isei, 35 (1935); KOYAMA in Bull. Nat. Sci. Mus. 11 : 167 (1968). — *Senecio farfaraefolius* var. *farfaraefolius* MAXIM. in Mél. Biol. 9 : 294 (1874) pro parte, Type from Mt. Hakone in Honshu. — *Cacalia hastata* subsp. *farfaraefolia* (MAXIM.) KITAM. in Acta Phytotax. Geobot. 7 : 247 (1938), Comp. Jap. III : 219 (1942) pro parte. — *Cacalia yakushimensis* HARA, Enum. Sperm. Jap. II : 151 (1952) pro parte, non MASAM. — *Cacalia hastata* var. *farfaraefolia* (MAXIM.) OHWI, Fl. Jap. Eng. ed. 884 (1965).

The present species has been considered as one of the most problematic taxa in this genus. Judging from the habitat and the slender frame of the plant, it may better be treated as a separate species, though further study will be necessary as to the difference between this species and some infraspecific taxa of *C. hastata*.

Endemic to southern half of central district of Honshu ; on humus in light forest of higher elevation of mountains.

Two varieties are distinguished by the feature of petiole.

Var. **maximowicziana**

Petioles wingless, not auricled at base.

Var. **alata** F. MAEKAWA in NAKAI Icon. Pl. As.-Or. I : 8, t. 4 (1935) Type : Honshu, Pref. Nagano : Kitazawa-pass in Mt. Yatsuga-dake, *G. Koidzumi* (Holotype in TI); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968). —

Cacalia hastata var. *alata* (F. MAEKAWA) KITAM. in Acta Phytotax. Geobot. 7 : 247 (1942), Comp. Jap. III : 220 (1942); OHWI, Fl. Jap. Eng. ed. 884 (1965). — *Cacalia yakushimensis* var. *alata* (F. MAEKAWA) NAKAI ex HARA, Enum. Sperm. Jap. II : 152 (1952).

This variety differs from the type variety in having the petioles with wings and auricles at base.

Cacalia yakushimensis MASAMUNE in Journ. Soc. Trop. Agr. Taiwan, 2 : 37 (1930), in Mem. Fac. Sci. et Agr. Taihoku Imp. Univ. 11, Bot. no. 4 : 451 (1934) Type from Yakushima Island, Kyushu; HARA, Enum. Sperm. Jap. II : 151 (1952) pro parte; KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968). — *Cacalia hastata* subsp. *farfaraefolia* (MAXIM.) KITAM. in Acta Phytotax. Geobot. 7 : 247 (1938), Comp. Jap. III : 219 (1942) pro parte.

Endemic to Yakushima Island, Kyushu; on humus in light forest of mountain.

Cacalia nokoensis MASAM. et SUZUKI, in Journ. Soc. Trop. Agr. Taiwan, 2 : 51 (1930) Type: Taiwan, Prov. Taihoku: en route from Onoe to Noko, S. Suzuki 2561 (Holotype in TAI); KITAM. Comp. Jap. III : 207 (1942); S.-Y. Hu in Quart. Journ. Taiwan Mus. 19 : 7 (1966).

Endemic to Taiwan; on grassy slope in high mountain, 2500 - 3000 m alt.

Cacalia hastata L. Sp. Pl. II : 835 (1753) Type from Siberia; KITAM. Comp. Jap. III : 215 (1942) incl. syn., pro parte; HARA, Enum. Sperm. Jap. II : 149 (1952); POJARKOVA, Fl. URSS, XXVI ; 687 (1961); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968).

The present species has been considered as one of the most difficult taxa in this genus. This variable species has wide distribution in northeast Asia and has various geographical races in its southern areas. According to my previous paper (1968), the following infra-specific taxa may better be acceptable, though further study is necessary particularly as to the plants in southern Korea.

Subsp. **hastata**. — HARA, Enum. Sperm. Jap. II : 149 (1952); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968).

Distribution: Siberia, Manchuria, northern China, northern Korea, Dauria, Primoskaja and Saghalien.

Subsp. **orientalis** KITAM. in Acta Phytotax. Geobot. 7 : 244 (1938), Comp. Jap. III : 216 (1942) excl. specim. of Honshu; HARA, Enum. Sperm. Jap. II : 149 (1952) pro parte; KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968). — *Senecio sagittatus* var. *glaber* MAXIM. in Mél. Biol. 9 : 293 (1874) pro parte, Type from Saghalien. — *Cacalia kitamurana* NAKAI in Bull. Nat. Sci. Mus. Tokyo, 31 : 114 (1952) et 33 : 23 (1953).

Four varieties are acceptable.

Var. **occidentalis**. — OHWI, Fl. Jap. Eng. ed. 884 (1965) pro parte, KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968).

Distribution: Dauria, northern Korea, Saghalien, Kuriles and Hokkaido; on grassy field at the edge of forest.

Var. **ramosa** (MAXIM.) KITAM. in Acta Phytotax. Geobot. 7 : 245 (1938),

Comp. Jap. III : 218 (1942); HARA, Enum. Sperm. Jap. II : 150 (1952); OHWI, Fl. Jap. Eng. ed. 884 (1965); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968). — *Senecio farfaraefolius* var. *ramosa* MAXIM. in Bull. Acad. St.-Pet. 19 : 484 (1874) Type from Honshu.

Endemic to Honshu.

Var. **hayachinensis** KITAM. in Acta Phytotax. Geobot. 14 : 180 (1952) Type Honshu, Pref. Iwate : Mt. Hayachine, *S. Kitamura* (Holotype in KYO); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968).

Endemic to Honshu ; restricted to Iwate prefecture.

Var. **nantaica** (KOMATSU) KITAM. in Acta Phytotax. Geobot. 7 : 247 (1938), Comp. Jap. III : 218 (1942); HARA, Enum. Sperm. Jap. II : 150 (1952); OHWI, Fl. Jap. Eng. ed. 884 (1965); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968). — *Cacalia nantaica* KOMATSU, Icon. Pl. Koish. 1-4 : 119 (1912) Type : Honshu, Pref. Tochigi : Mt. Nantai, *S. Komatsu* (Holotype in TI).

Endemic to Honshu ; restricted to northwest Tochigi prefecture.

Subsp. **tanakae** (FR. et SAV.) H. KOYAMA stat. nov. — *Senecio farfaraefolius* var. *tanakae* FR. et SAV. Enum. Pl. Jap. II : 653 (1879) Type from Japan.

— *Cacalia hastata* subsp. *orientalis* var. *tanakae* (FR. et SAV.) KITAM. in Acta Phytotax. Geobot. 7 : 246 (1938), Comp. Jap. III : 217 (1942); HARA, Enum. Sperm. Jap. II : 150 (1952).

Two varieties are recognizable.

Var. **tanakae**. — *Cacalia hastata* var. *tanakae* (KITAM.) OHWI, Fl. Jap. Eng. ed. 884 (1965).

Endemic to Honshu, restricted to Japan sea side of northern Honshu.

Var. **chokaiensis** (KUDO) KITAM. in Acta Phytotax. Geobot. 7 : 246 (1938), Comp. Jap. III : 218 (1942); HARA, Enum. Sperm. Jap. II : 150 (1952); OHWI, Fl. Jap. Eng. ed. 884 (1965); KOYAMA in Bull. Nat. Sci. Mus. Tokyo, 11 : 167 (1968). — *Cacalia chokaiensis* KUDO in Bot. Mag. Tokyo, 29 : 227 (1915) Type from Mt. Chokai, Akita prefecture in Honshu.

Endemic to Honshu, restricted to Japan sea side of northern Honshu.

Following Chinese variety may better be placed in the present species, though further study is required as to the taxonomical position.

Var. *lancifolia* (FRANCH.) H. KOYAMA comb. nov. — *Senecio sagittatus* var. *lancifolius* FRANCH. in MOROT Journ. Bot. 10 : 421 (1896) Type from Prov. Szechwan.

The following Chinese or Himalayan species may be referred to this series.

Cacalia deltophylla (MAXIM.) MATTF. ex RHEDER et KOBUSKI in Journ. Arn. Arb. 14 : 39 (1933). — *Senecio deltophyllus* MAXIM. in Bull. Acad. Petersb. 27 : 487 (1881) Type from Prov. Kansu.

Cacalia leucanthema (DUNN) LING in Contr. Inst. Bot. Nat. Acad. Peiping, 2 : 528 (1934). — *Senecio leucanthemus* DUNN in Journ. Linn. Soc. Bot. 35 : 506 (1903) Type from Patung, Prov. Hupeh.

Cacalia levingii (CLARKE) H. KOYAMA comb. nov. — *Senecio levingii* CLARKE. Comp. Ind. 301 (1876) Type from Sonamurg, Kashmir.

Cacalia macrocephala HAND.-Mzt. in Notizbl. Bot. Gart. Berlin, 13: 633 (1937) Type from Prov. Szechuan, S-Wushan.

Cacalia latipes (FRANCH.) HAND.-Mzt. Symb. Sin. Pt. VII: 1129 (1936).

— *Senecio latipes* FRANCH. in MOROT Journ. de Bot. 8: 356 (1894) Type from Prov. Yunnan.

Series **Pinnatae** H. KOYAMA ser. nov.

Folia anguste ovato-deltoides vel oblanceolate-cordata, nervis lateralibus numerosis pinnatis, subtus dense arachnoidea. Antherae basi sagittatae non elongatae. Typus: *C. penninervis* H. KOYAMA.

This series is characterized by the shape and venation of leaf and comprises a Himalayan species which is newly described in this paper. Style branches of this series are more or less similar to those of *Senecio*, though the other characters are mostly of *Cacalia*. Color of florets of this series is not confirmed as to the living materials. Chromosomes are not yet examined. Thus, further study is necessary as to the taxonomical position of this series.

Cacalia penninervis H. KOYAMA sp. nov.

Caulis simplex erectus inferne 5 mm diametro denis crispatopuberulus, superne parce breviter ramosus, ramis ascendentibus. Folia caulina numerosa, media pauca longe petiolata, petiolis usque ad 2.5 - 3 cm longis exalatis arachnoideis puberulisque basi non auriculatis, laminis saepe 10 cm longis 5 cm latis anguste ovato-deltoides, apice acutis basi leviter cordatis margine irregulariter mucronulato-denticulatis, nervis lateralibus numerosis pinnatis, supra minute crispato-puberulis subtus incano-araneoso-tomentosis, folia superiora subabrupte minora breviter petiolata, sub inflorescentia linearis-lanceolata. Capitula anguste paniculatim disposita numerosa, pedunculis 2 - 5 mm longis, bracteis linearibus circa 6 mm longis instructis vel ebracteatis. Involucrum cylindricum 7 mm longum medio circa 3 mm latum in sicco, basi bracteis circa 3 linearibus 3 - 4 mm longis calyculatum, squamae 5 anguste oblongae apice obtusae dorso parce puberulae. Flosculus 5 (-6), corolla 6 mm longa, parte angusta tubi 2.5 mm longa, lobis 1 mm longis apice corniculato-incrassatis. Receptaculum planum alveolatum. Antherae basi breviter bifidae, auriculis contiguis connatis brevibus; filamenta superne bulboso-incrassata. Styli rami apice obtusi hirsuti. Achenia cylindrica 3 mm longa 0.8 mm lata striata glabra apice truncata basi parum angustata. Pappus 4 - 5 mm longus sordide albescens, setis copiosis subaequilongis minutissime scabris.

Typus: Central NEPAL P. 29, near C. 1, 4500 m alt., T. Namba 101501 (Holotype in KYO).

C. NEPAL P. 29, East Peak, 4500 m alt., T. Namba 102201 (KYO). BHUTAN Yale La, 3800 m alt., S. Nakao 569 (KYO).

S. Nakao 569 has broader leaves (being ovate-cordate and acuminate at the tip, 13 cm long and 8 cm wide) and fairly longer involucres (8 mm long), and longer achenes (3 mm long). S. Nakao 569 is, however, similar to the type specimen by the other characters.

The leaf of this species has pinnate venation and white cottony beneath.

As to the shape and venation of leaf, the present species is unique among the genus *Cacalia*, though some Himalayan *Senecios* have similar leaf to that of the present species.

Cacalia penninervis is more or less similar to *Senecio candolleanus* which has discoid heads, though it is clearly distinguished from *S. candolleanus* by having glabrous achenes.

References of Chromosome numbers

- AFZELIUS, K. 1924. Embryologische und Zytologische Studien in *Senecio* und verwandten Gattungen. *Acta Hort. Berg.* 8 : 123-219.
- ARANO, H. 1964. Cytological studies in subfamily Carduoideae (Compositae) of Japan XVII. The karyotype analysis in *Cacalia* and *Syneilesis*. *Bot. Mag. Tokyo*, 77 : 86-97.
- BEAMAN, J. H. & B. L. TURNER, 1962. Chromosome numbers in Mexican and Guatemalan Compositae. *Rhodora*, 64 : 271-276.
- KOYAMA, H. 1961. Chromosome numbers in some Japanese species of *Cacalia* and the allied genera. *Acta Phytotax. Geobot.* 19 : 18-19.
- KOYAMA, H. 1964. On the chromosome number of *Cacalia nokoensis*. *Acta Phytotax. Geobot.* 21 : 28.
- KOYAMA, H. 1966. Cytotaxonomic studies of Compositae 2. On *Cacalia auriculata* var. *kamtschatica*. *Acta Phytotax. Geobot.* 22 : 11-14.
- KOYAMA, H. 1966. Chromosome numbers in some species of Compositae. *Acta Phytotax. Geobot.* 22 : 80.
- KOYAMA, H. 1967. Taxonomic studies on the tribe Senecioneae of Eastern Asia I. General part. *Mem. Coll. Sci. Univ. Kyoto. Series B.* 33 : 183-209.
- KOYAMA, H. 1968. Cytotaxonomic studies of Compositae 3. On the species problems in Japanese *Cacalia hastata* and its allies. *Bull. Nat. Sci. Mus.* 11(2) : 167-177.
- ORNDUFF, R., T. MOSQUIN, D. W. KYHOS & P. H. RAVEN, 1967. Chromosome numbers in Compositae VI. Senecioneae II. *Amer. Journ. Bot.* 54 : 205-213.
- TAKESHITA, M. 1961. Cytological studies on *Cacalia* and its related genera. I. The chromosome number of three species and one variety of *Cacalia* and one species of *Miricacalia*. *Jap. Journ. Genet.* 36 : 217-220.
- TURNER, B. L., M. POWELL & R. M. KING, 1962. Chromosome numbers in the Compositae. VI. Additional Mexican and Guatemalan species. *Rhodora*, 64 : 251-271.

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(Received Nov. 25, 1968)

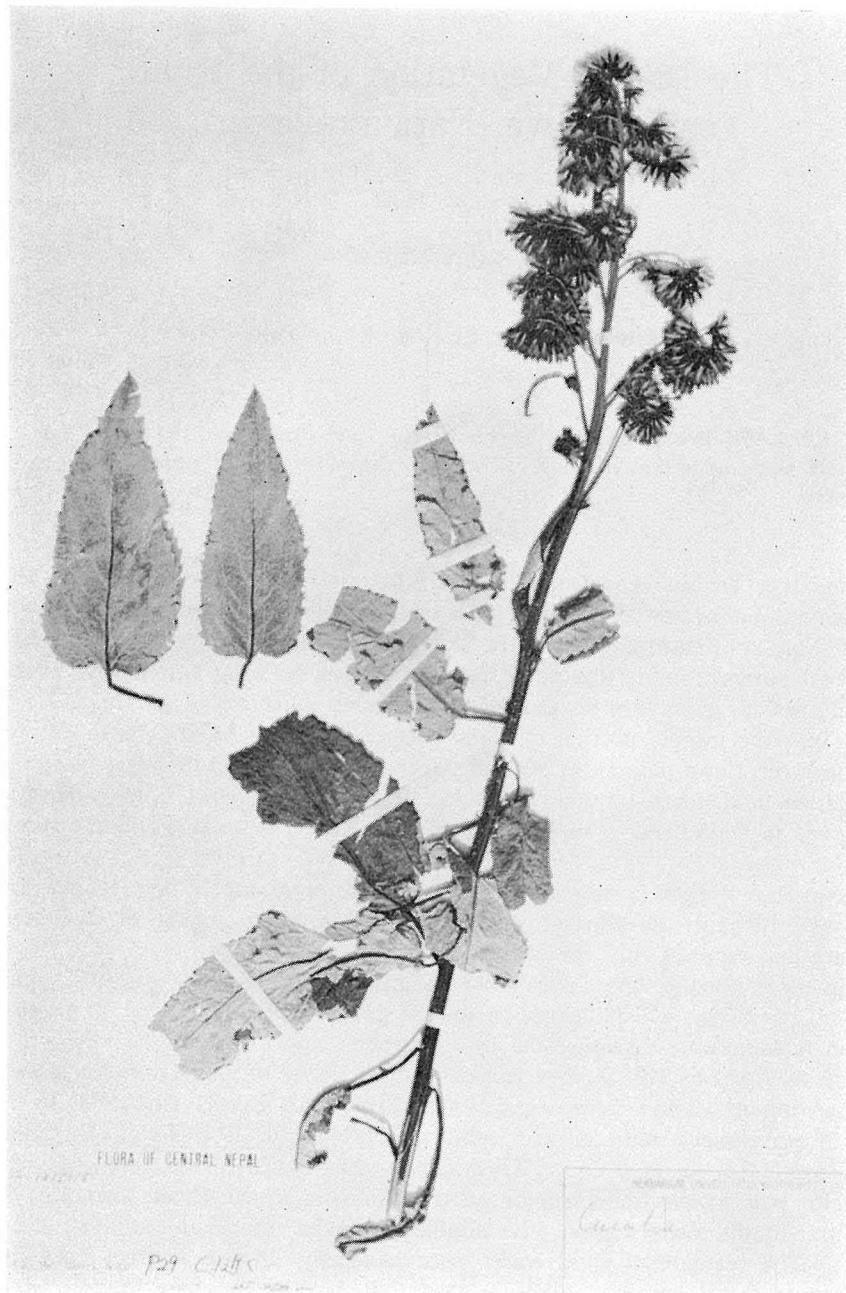


Plate 1. Holotype of *Cacalia penninervis* H. KOYAMA