日本産アキギリ属の核形態学的比較

著者	Funamoto Tsuneo, Harana Tomoko, Nakamura Takuzo
著者別表示	船本 常男, 図師 正敏, 原名 智子, 中村 卓造
journal or publication title	The journal of phytogeography and taxonomy
volume	48
number	1
page range	11-18
year	2000-08-31
URL	http://doi.org/10.24517/00055277

Journal of Phytogeography and Taxonomy 48 : 11-18, 2000

Tsuneo Funamoto, Masatoshi Zushi, Tomoko Harana and Takuzo Nakamura : **Comparative karyomorphology of the Japanese species of *Salvia* L. (Lamiaceae)**

Biological Institute, Showa Pharmaceutical University, 3-chome, Higashi-Tamagawagakuen, Machida City, Tokyo 194-8543, Japan

Abstract

Ten species and one variety of *Salvia* in Japan had common karyomorphology of the complex chromocenter type in the resting stage, the proximal type in the mitotic prophase chromosomes, and the chromosome number of 2n=16. The chromosome number of *S. koyamae, S. glabrescens, S. lutescens* f. *lobato-crenata*, *S. isensis*, *S. ranzaniana*, *S. pygmaea*, *S. omerocalyx* var. *omerocalyx* and *S. omerocalyx* var. *prostrata* were counted here for the first time, while that of *S. nipponica*, *S. plebeia* and *S. japonica* verified the previous reports. Two largest chromosomes of *S. plebeia* were median-centromeric and were different from those of the other ten taxa which were subterminal-centromeric. The two largest chromosomes in each of the ten taxa had commonly satellites on the short arm.

Key words : Japan, karyomorphology, Lamiaceae, *Salvia*.

Introduction

Genus *Salvia* L., which consists of over 900 species (Standley and Williams 1973), is the largest of the Lamiaceae (Labiatae) and is found in subtropical and temperate regions of the world. Among the ten species of the genus distributed in Japan, eight species are endemic (Murata and Yamazaki 1993).

Chromosome studies have been made in about 210 non-Japanse species of the genus, and reported 35 different chromosome numbers of 2n=12 up to 2n=72+2B as aneuploid and polyploid (e.g., Scheel 1931; Stewart 1939; Delestaing 1954; Epling et al. 1962; Gadella et al. 1966; Gill 1971, 1984; Chuksanova and Kaplanbekova 1971; Afzal-Rafii 1971, 1972, 1976, 1980; Patudin et al. 1975; Wu and Huang 1975; Magulaev 1976; Haque and Ghoshal 1980; Markova and Ivanova 1982; Rosúa and Blanca 1985, 1988; Palomino et al. 1986; Mercado et al. 1989; Cherian and Kuriachan 1990). In contrast, chromosome studies of only three species of Japanese *Salvia* have been made; 2n=16 (Morinaga et al. 1929; Scheel 1931; Carlson and Stuart 1936) in *S. nipponica*, n=16, 18 (Wu and Huang 1975) and 2n=16 (Choshi 1968) in *S. japonica*, n=8 (Mehra and Gill 1968; Vij and Kashyap 1975, 1976; Bir et al. 1978; Saggoo and Bir 1983), n=8+1B (Gill 1984), 2n=16 (Bir and Sidhu 1980) and 2n=32 (Ayyangar and Vembu 1984) in *S. plebeia*.

This paper reports on karyomorphology of the species of *Salvia* in Japan.

Materials and methods

Eighty plants of ten species and one variety of Japanese *Salvia* were collected in 24 localities (Table 1) and were cultivated in pots in the experimental garden of the Showa Pharmaceutical University. Karyomorphological observations were made in fresh root-tip cells. Root tips were pretreated in 2 mM 8-hydroxyquinoline for 4 h at ca. 20℃, fixed in 45% acetic-acid for 10 min at ca. 2℃, macerated in a mixture of 45% acetic-acid and 1 N hydrochloric-acid (1 : 1) for 20-23 sec at ca. 60℃, and then stained and squashed in 2% aceto-orcein.

Karyomorphological expression of the resting stage and the mitotic prophase chromosomes were classified according to Tanaka (1971, 1977) and the mitotic metaphase chromosomes by the centromeric position accepted by Levan et al.

Table 1. Localities, samples and chromosome numbers of Japanese *Salvia*

Species	Locality	Sample number	Chromosome number(2n)
S. koyamae Makino	Nagano Pref., Minamisaku-gun, Usuda-machi, Mizuochi	6	16
S. nipponica Miq.	Niigata Pref., Nishikanbara-gun, Yahiko-mura, Mt. Yahiko	3	16
	Yamanashi Pref., Nakakoma-gun, Ashiyasu-mura, Yashajin-toge	2	16
	Kumamoto Pref., Kikuchi City, Kikuchi-keikoku	4	16
S. glabrescens Makino	Fukui Pref., Katsuyama City, Iwaya	3	16
	Fukui Pref., Ono-gun, Izumi-mura, Shimohanbara	4	16
	Gifu Pref., Ibi-gun, Fujihashi-mura, Tokuyama	3	16
S. plebeia R. Br.	Gunma Pref., Annaka City, Yanase	4	16
S. japonica Thunb.	Chiba Pref., Awa-gun, Amatsukominato-machi, Mt. Kiyosumi	2	16
	Toyama Pref., Kaminiikawa-gun, Oyama-machi, Arimineko	2	16
	Gifu, Pref., Kaidu-gun, Nannou-cho, Ishizu	1	16
	Shizuoka Pref., Fujieda City, Nishikata	2	16
	Kyoto Pref., Funai-gun, Hiyoshi-cho, Kamisegi	2	16
	Okayama Pref., Maniwa-gun, Yatsuka-son, Basari-toge	3	16
S. lutescens (Koidz.) Koidz. f. *lobato-crenata* (Makino) Murata	Aichi Pref., Kitashitara-gun,Shitara-cho, Onakura	4	16
	Aichi Pref., Kitashitara-gun,Inabu-cho, Noiri	2	16
S. isensis Nakai ex H. Hara	Shizuoka Pref., Inasa-gun,Inasa-cho, Kurumegi	4	16
	Shizuoka Pref., Inasa-gun,Inasa-cho, Ihei	3	16
S. ranzaniana Makino	Mie Pref., Taki-gun, Miyagawa-mura, Mobara	3	16
	Mie Pref., Owase City, Kuchisubo	4	16
S. pygmaea Matsum.	Okinawa Pref., Yaeyama-gun,Taketomi-cho, Urauchi	3	16
	Okinawa Pref., Yaeyama-gun,Taketomi-cho, Komi	8	16
S. omerocalyx Hayata var. *omerocalyx*	Tottori Pref., Yazu-gun, Wakasa-cho, Mt. Ogino-sen	5	16
S. omerocalyx Hayata var. *prostrata* Satake	Fukui Pref., Mikata-gun, Mikata-cho, Kitamaekawa	3	16

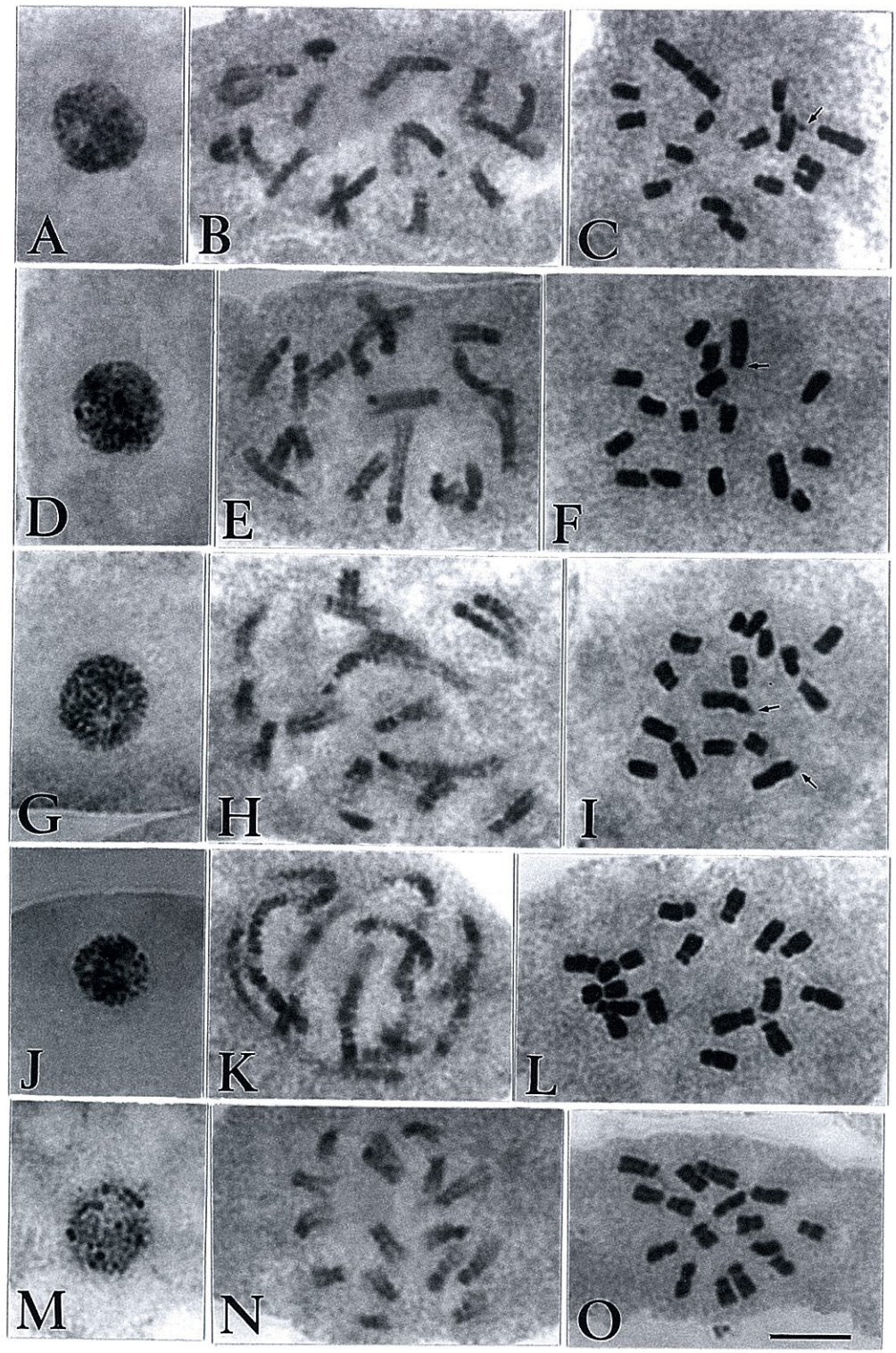

Fig. 1. Karyomorphology of Japanese species of *Salvia*.
A-C: *S. koyamae*; D-F: *S. nipponica*; G-I: *S. glabrescens*; J-L: *S. plebeia*; M-O: *S. japonica*. Nuclei with resting chromosomes (A, D, G, J and M). Mitotic prophase chromosomes (B, E, H, K and N). Mitotic metaphase chromosomes, 2n=16 (C, F, I, L and O). Arrows represent satellites. Bar=5 μm.

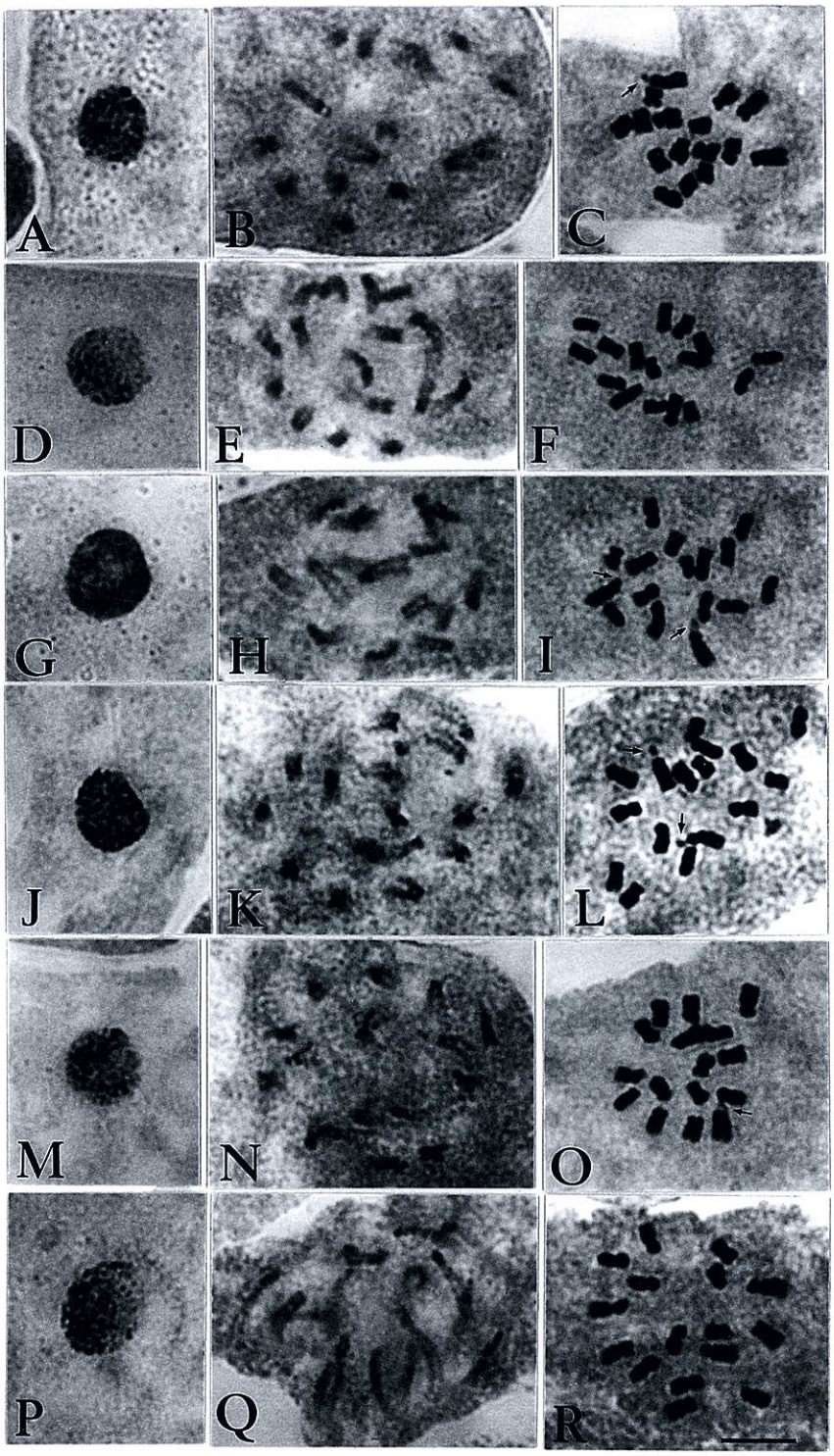

Fig. 2. Karyomorphology of Japanese species of *Salvia*.
A-C: *S. lutesecens* f. *lobato-crenata*; D-F: *S. isensis*; G-I: *S. ranzaniana*; J-L: *S. pygmaea*; M-O: *S. omerocalyx* var. *omerocalyx*; P-R: *S. omerocalyx* var. *prostrata*. Nuclei with resting chromosomes (A, D, G, J, M and P). Mototic prophase chromosomes (B, E, H, K, N and Q). Mitotic metaphase chromosomes, 2n=16 (C, F, I, L, O and R). Arrows represent satellites. Bar=5 μm.

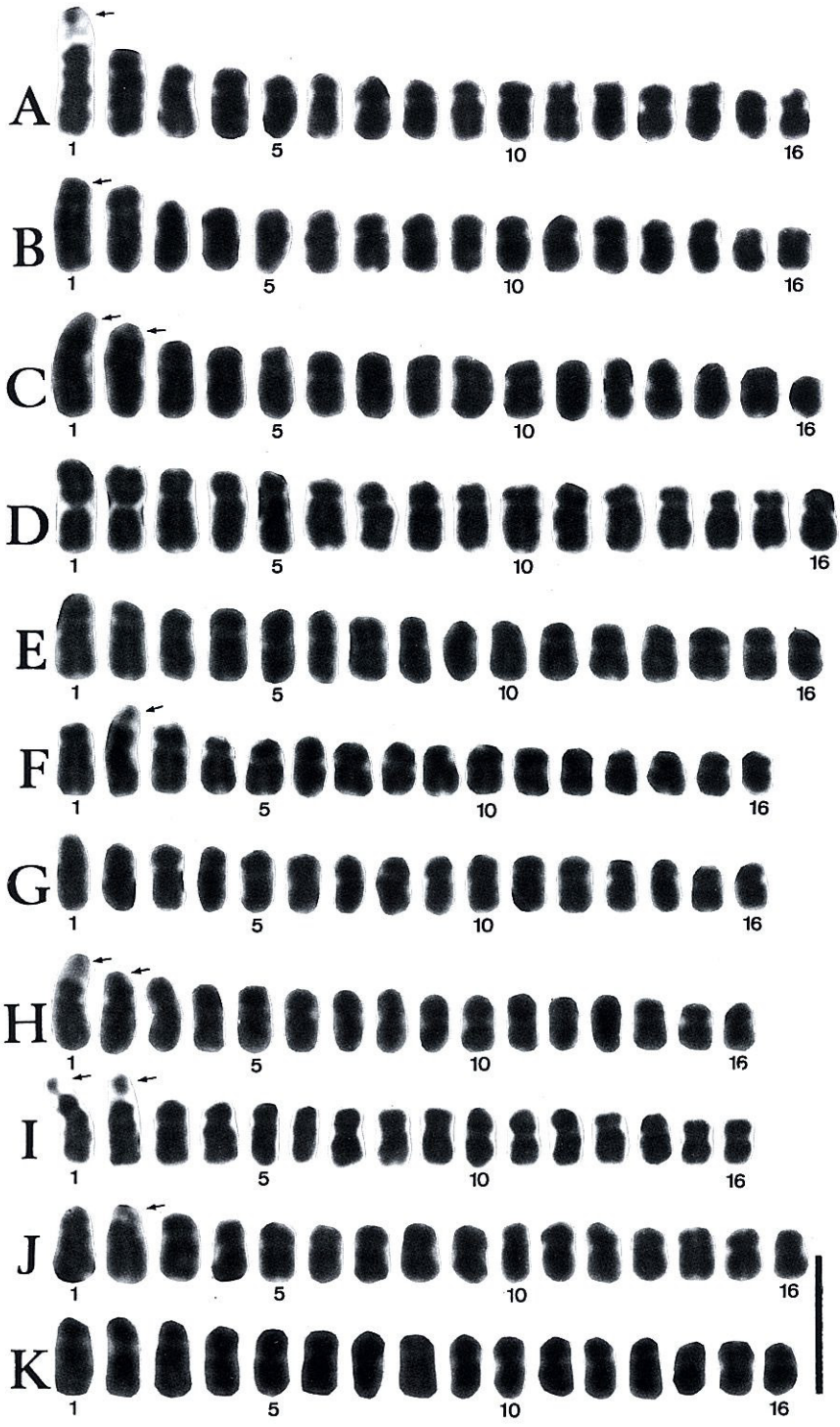

Fig. 3. Karyotypes of Japanese species of *Salvia*.
A: *S. koyamae* ; B: *S. nipponica* ; C: *S. glabrescens* ; D: *S. plebeia* ; E: *S. japonica* ; F: *S. lutesecens* f. *lobato-crenata* ; G: *S. isensis* ; H: *S. ranzaniana* ; I: *S. pygmaea* ; J: *S. omerocalyx* var. *omerocalyx* ; K: *S. omerocalyx* var. *prostrata*. Arrows represent satellites. Bar=5 μm.

(1964). Taxonomical treatment followed Murata and Yamazaki (1993). The voucher specimens were deposited in the Showa Pharmaceutical University.

Results and discussion

The ten species and one variety of *Salvia* in Japan investigated had in common the following karyomorphology; the complex chromocenter type of the resting stage which had many chromomeric granules and chromocentral small blocks scattered in the whole region (Fig. 1 A, D, G, J, M and Fig. 2 A, D, G, J, M, P) and the proximal type of the mitotic prophase chromosomes in which the early condensed segments were confined to the proximal part of the both short and long arms or only to the short arm (Fig. 1 B, E, H, K, N and Fig. 2 B, E, H, K, N, Q). The 11 taxa had commonly 2n=16 chromosomes (Fig. 1 C, F, I, L, O and Fig. 2 C, F, I, L, O, R). Neither intraspecific polyploid nor aneuploid were observed in the taxa (Table 1). The somatic chromosome numbers of *S. koyamae* Makino, *S. glabrescens* Makino, *S. lutescens* (Koidz.) Koidz. f. *lobato-crenata* (Makino) Murata, *S. isensis* Nakai ex H. Hara, *S. ranzaniana* Makino, *S. pygmaea* Matsum., *S. omerocalyx* Hayata var. *omerocalyx* and *S. omerocalyx* Hayata var. *prostrata* Satake were reported here for the first time, while those of *S. nipponica* Miq., *S. plebeia* R. Br. and *S. japonica* Thunb. verified the previous reports (e.g., Morinaga et al. 1929; Choshi 1968; Mehra and Gill 1968; Bir and Sidhu 1980). These taxa of the genus had similar karyotypes; gradual decrease in chromosome length from the longest to the shortest chromosomes, and the chromosome complement of 2n=16 consisted of median-, submedian-and subterminal-centromeric chromosomes. The two longest chromosomes of *S. plebeia* were median-centromeric (Fig. 3 D), while those of the other ten taxa were subterminal-centromeric. Satellite was observed basically in the short arm of the two longest chromosomes (Fig. 3 A–C, E–K). This difference in centromeric position was correlated with life span; annual or biennial life span in *S. plebeia* and perennial life span in the other ten taxa.

Variations of chromosome numbers in *Salvia* were recognized in respective continent; polyploid and aneuploid with mainly 2n=12, 14, 16, 20, 22 in *Salvia* in Europe and South, Central and South-east Asia continents (e.g., Gadella et al. 1966; Bothmer 1970; Gill 1971; Patudin et al. 1975; Haque and Ghoshal 1980; Markova and Ivanova 1982; Cherian and Kuriachan 1990), polyploid and aneuploid with 2n=12, 16, 20, 22 in *Salvia* in North and Central American continents (Stewart 1939; Epling et al. 1962; Palomino et al. 1986; Mercado et al. 1989), polyploid and aneuploid with 2n=14, 16, 18, 20, 22 in *Salvia* in Africa continent (e.g., Delestaing 1954; Hedge 1974). However, such variation of chromosome numbers was not well differentiated in Japanese species of *Salvia*. The Japanese species of *Salvia* may not be chromosomally diversified.

Acknowledgements

We express our cordinal thanks to Dr. Katsuhiko Kondo, Professor of Botany, Hiroshima University, for many pertinent comments and critical reading of the manuscript, and to Dr. Goro Kokubugata, Tsukuba Botanical Garden, National Science Museum, for supplying *Salvia pygmaea*.

References

Afzal-Rafii, Z. 1971. Contribution a l'etude cytotaxinomique des *Salvia* de Turquie. Bull. Soc. Bot. France **118**: 69–76.

Afzal-Rafii, Z. 1972. Contribution a l'etude cytotaxinomique des *Salvia* de Turquie, II. Bull. Soc. Bot. France **119**: 167–176.

Afzal-Rafii, Z. 1976. Etude cytotaxinomique et phylogenetique de quelques *Salvia* de la region mediterraneene: Group du *Salvia officinalis* L. Bull. Soc. Bot. France **123**: 515–531.

Afzal-Rafii, Z. 1980. Love, A. (ed.). Chromosome number reports LXVII. Taxon **29**: 347–367.

Ayyangar, K.R. and Vembu, B. 1984. On the karyomorphological nuances between two species of *Salvia* Linn. Proc. Indian Sci. Congr. **71** (3,VI): 81.

Bir, S.S., Kumarl. S., Shoree, S.P. and Saggoo, M.I.S. 1978. Cytological studies in certain Bicarpellatae from north and central India. J. Cytol. Genet. **13**: 99–106.

Bir, S.S. and Sidhu, M.K. 1980. Cytopalynological studies on weed flora of cultivable lands of Patiala district (Punjab) . J. Palynology **16**: 85–105.

Bothmer, R. 1970. Studies in the Aegean flora XV, Chromosome numbers in Labiatae. Bot. Notiser **123**: 52–60.

Carlson, E.M. and Stuart, B.C. 1936. Development of species and gametophytes in certain new world species of *Salvia*. New Phytol. **35**: 68–91.

Cherian, M. and Kuriachan, P.I. 1990. Cytotaxonomy of the tribe Salvieae (Labiatae) in south India. Proc. Indian Sci. Congr. **77** (3, VI) : 148–149.

Choshi, A. 1968. New observation on the prolification in *Salvia*. Rep. Fac. Sci. Shizuoka Univ. **3**: 27–34.

Chuksanova, N.A. and Kaplanbekova, S.A. 1971. Chromosome numbers in certain species of Labiatae Juss. and Scrophulariaceae Lindl. indigenous to the U.S.S.R. Bot. Zhurn. **56**: 522–528. (in Russian)

Delestaing, N. 1954. Contribution a l'etude cytologique du genre *Salvia*. Rev. Cytol. Biol. Veg. **15**: 195–236.

Epling, C., Lewis, H. and Raven, P.H. 1962. Chromosome numbers of *Salvia*: Section Audibertia. Aliso **5**: 217–221.

Gadella, T.W.J., Kliphuis, E. and Mennega, E.A. 1966. Chromosome numbers of some flowering plants of Spain and S. France. Acta Bot. Neerlandica **15**: 484–489.

Gill, L.S. 1971. Chromosome studies in *Salvia* (Labiatae) : West-Himalayan species. Experimenta **15**: 596–598.

Gill, L.S. 1984. The incidence of polyploidy in the West-Himalayan Labiatae. Rev. Cytol. Biol. Veg. Bot. **7**: 5–16.

Haque, M.S. and Ghoshal, K.K. 1980. Karyotypes and chromosome morphology in the genus *Salvia* Linn. Cytologia **45**: 627–640.

Hedge, I.C. 1974. A revision of *Salvia* in Africa, including Madagascar and the Canary Islands. Notes from the Royal Botanical Garden, Edinburgh **33**: 1–121.

Levan, A., Fredga, K. and Sandberg, A.A. 1964. Nomenclature of centromeric position on chromosomes. Hereditas **52**: 201–220.

Magulaev, A.J. 1976. The chromosome numbers of flowering plants of the northern Caucasus (Part II). The Flora of the Northern Caucasus **2**: 51–62.

Markova, M.L. and Ivanova, P.S. 1982. Karyological study of the genus *Salvia* L. in Bulgaria. Filologija (Sofia) **20**: 3–19. (in Bulgarian)

Mehra, P.N. and Gill, L.S. 1968. Love, A. (ed.). IOPB chromosome number reports XVIII. Taxon **17**: 419–422.

Mercado, P., Ramamoorthy, T.P. and Palomino, G. 1989. Karyotypes of five Mexican species of *Salvia* subgenus *Calosphace* (Lamiaceae). Cytologia **54**: 605–608.

Morinaga, T., Fukushima, E., Kano, T., Maruyama, Y. and Yamazaki, Y. 1929. Chromosome numbers of cultivated plants II. Bot. Mag. Tokyo **43**: 589–594.

Murata, G. and Yamazaki, T. 1993. *Salvia* L. Iwatsuki, K., Yamazaki, T., Boufford, D.E. and Ohba, H. (eds.). Flora of Japan IIIa, pp. 302–307. Kodansha, Tokyo.

Palomino, G., Mercado, P. and Ramamoorthy, T. P. 1986. Chromosomes of *Salvia* subgenus *Calosphace* (Lamiaceae), a preliminary report. Cytologia **51**: 381–386.

Patudin, A.V., Yurtsev, V.N. and Pakaln, D.A. 1975. Chromosome number in some species of *Salvia* L. (Lamiaceae). Bot. Zhurn. **60**: 529–534. (in Russian)

Rosua, J.L. and Blanca, G. 1985. Notas cariosistematicas de la section Salvia del genero *Salvia* L. (Lamiaceae). Anales Jard. Bot. Madrid **42**: 101–112.

Rosúa, J.L. and Blanca, G. 1988. Revision del género *Salvia* L. sec. Aediterranero occidental. Collect. Bot. (Barcelona) **17**: 205–236.

Saggoo, M.I.S. and Bir, S.S. 1983. Cytopalynological studies on Indian members of Acanthaceae and Labiatae. J. Palynol. **19**: 243–277.

Scheel, M. 1931. Karyologische Untersuchung der Gattung *Salvia*. Bot. Arch. **32**: 148–208

Standley, P. and Williams, L. 1973. Labiatae. Fieldiana Bot. **24**: 237–317.

Stewart, W.M.S. 1939. Chromosome numbers of Californian salvias. Amer. J. Bot. **26**: 730–733.

Tanaka, R. 1971. Types of resting nuclei in Or-

chidaceae. Bot. Mag. Tokyo **84**: 118–122.
Tanaka, R. 1977. Recent karyotype studies. Ogawa, K., Kurozumi, K., Koike, S. and Sato, S. (eds.). Plant cytology, pp. 293–326. Asakura Book, Tokyo. (in Japanese)
Vij, S.P. and Kashyap, S.K. 1975. Love, A. (ed.). IOPB chromosome number reports XLVIII. Taxon **24**: 367–372.
Vij, S.P. and Kashyap, S.K. 1976. Cytological studies in some north Indian Scrophulariaceae. Cytologia **41**: 685–695.
Wu, J.T. and Huang, T.C. 1975. Biosystematic studies of Formosan *Salvia*. Taiwania **20**: 77–98.
(Recieved February 10, 2000; accepted March 28, 2000)

船本常男・図師正敏・原名智子・中村卓造：日本産アキギリ属の核形態学的比較

日本産アキギリ属10種1変種について核形態の比較を行った。11 taxaはともに静止期は複雑染色中央粒型，分裂期前期染色体は基部型であった。分裂期中期においても染色体数は11 taxaとも2n=16であり，倍数体，異数体は全く観察されなかった。シナノアキギリ，アキギリ，ナツノタムラソウ，シマジタムラソウ，ハルノタムラソウ，ヒメタムラソウ，タジマタムラソウ，ハイタムラソウの染色体数は今回始めて観察され，キバナアキギリ，ミゾコウジュ，アキノタムラソウの染色体数は今までの報告と一致した。11 taxaとも染色体は最大染色体から最小染色体まで勾配的な長さの変化を示し，中部型，次中部型及び次端部型染色体で構成されていた。唯一の違いは最大染色体対がミゾコウジュは中部型，他の10 taxaは次端部型で，短腕部に付随体が観察された。

(〒194-8543　東京都町田市東玉川学園三丁目3165　昭和薬科大学生物学教室)