

Taxonomic Reconsideration of *Lysimachia ardisioides* (Primulaceae) from Taiwan

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Abstract. Morphology and chromosome number were compared between accessions of *Lysimachia sikokiana* from Japan and "*L. ardisioides*" from Taiwan. These accessions were clearly divided into two groups based on the stem morphology and chromosome number: one is consisted of accessions from Japan, with alate stems and $2n=60$; and the other group is consisted of accessions from Taiwan, with terete stems and $2n=30$. This result supports clearly that "*L. ardisioides*" in question belongs to the different species from *L. sikokiana* as stated by Masamune (1932).

Key words: Chromosome, *Lysimachia*, Primulaceae, stem morphologies, taxonomy.

Introduction

The genus *Lysimachia* is one of the largest genera in Primulaceae (Marr and Bohm, 1997) comprising about 180 species, and is primarily distributed in the temperate region of Asia (ca. 122 spp.; Chen & Hu, 1979). Miquel (1867) described *Lysimachia sikokiana* based on a type specimen collected from Awa, Tokushima, Japan (*Unknown Japanese s. n.*, deposited in L), and stated that *L. sikokiana* had wings on the stem (angulate). This species has been recorded from not only Japan but also Taiwan (e.g., Matsumura & Hayata, 1906). Thereafter, Masamune (1932) distinguished the Taiwanese species, previously known as *L. sikokiana*, from the Japanese *L. sikokiana*, and described it as *L. ardisioides* based on a type specimen collected from Wulai, Taipei (*Y. Yamamoto s. n.*, deposited in TAI). He (1932) stated that *L. ardisioides* was morphologically distinguishable from *L. sikokiana* by the

stem lacking wings (terete), and considered it to be endemic to Taiwan. His taxonomic concept was followed by Kao and Devol (1978), Kao and Peng (1998), and Hu and Kelso (2000). On the other hand, Chen and Hu (1989) treated *L. ardisioides* as a junior synonym of *L. sikokiana*.

The present study highlights clearing this taxonomic problem on the basis of detailed examination of morphology and cytological analysis using living and herbarium material.

Materials and Methods

Plant materials

Plant materials were collected from fifteen localities in Japan (11) and Taiwan (4) (Table 1; Fig. 1). These accessions were cultivated under uniform environment of the experimental greenhouse of Tsukuba Botanical Garden for cytological analysis. Voucher specimens of these accessions were deposited in the herbaria of Academia

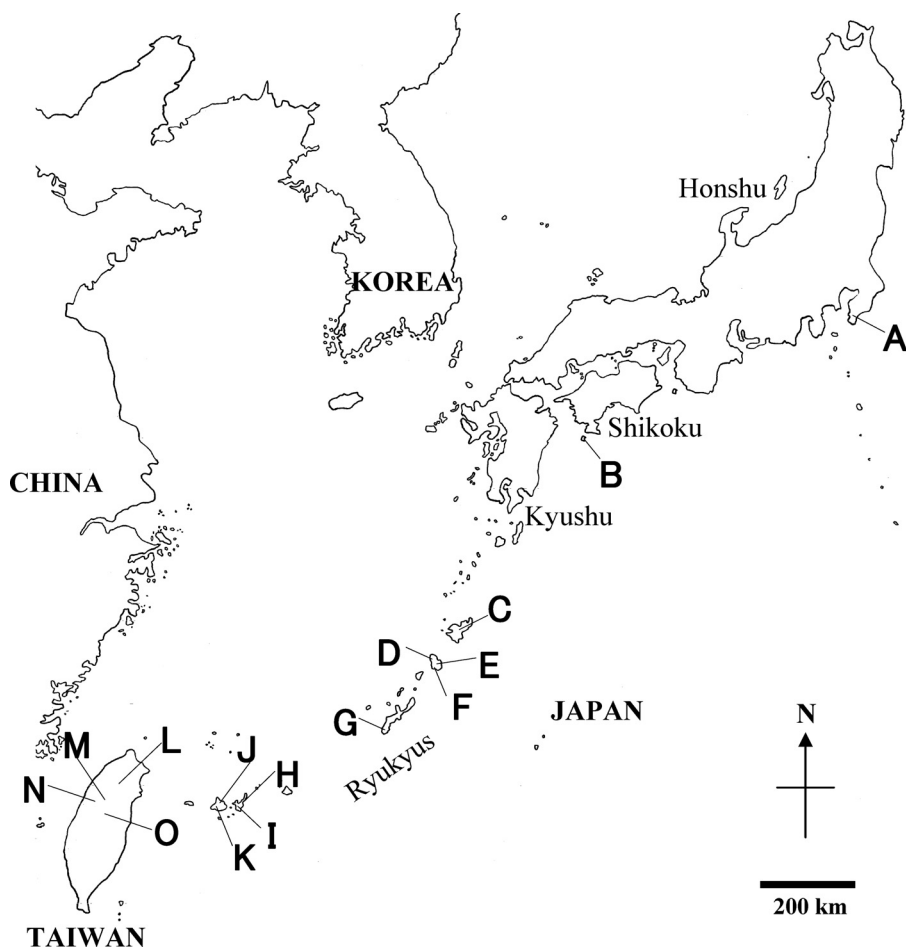


Fig. 1. Map showing localities of 15 accessions investigated. Alphabetical codes correspond to those in Table 1.

Sinica, Taipei (HAST), Makino Botanical Garden, Kochi (MBK), and the National Science Museum, Tokyo (TNS) (Table 1).

Morphological characters

Morphological characters of habit, corolla, and stem were compared between the fifteen accessions. For stem morphology, the fifteen accessions were used after a year cultivation in the greenhouse mentioned above, and then a newly-developing stem node between the third and fourth leaves (from the top) of each accession was compared. Along with these living material we also examined a total of 164 specimens collected from Japan and Taiwan, and deposited in the herbaria of HAST, Faculty of Science, University

of the Ryukyus (RYU), National Taiwan University (TAI), Taiwan Forest Research Institute (TAIF), the National Museum of Natural Science, Taichung (TNM), and TNS.

Chromosome observation

Root tips were cut out from each accession and pretreated in 2 mM 8-hydroxyquinoline at 20°C for two hours, then fixed in acetic ethanol (1:3) at 4°C for 2 h at least. The fixed root tips were macerated in a mixture of 1 N hydrochloric acid and 45% acetic acid at 60°C for 10 second. Somatic chromosomes at mitotic metaphase were stained in 2% aceto-orcein for 2 h, and spread by the standard squash method.

Table 1. Fifteen accessions of *Lysimachia sikokiana* and “*L. ardisioides*” with their character states.

Locality	Collection no. ¹	Code in Fig. 1	Stem condition	Chromosome no. (2n)
Japan, Honshu: Kanayama, Kamogawa-shi, Chiba	<i>G. Kokubugata</i> 3757	A	alate	60
Japan, Shikoku: Hirose, Okinoshima-cho, Sukumo-shi, Kochi	<i>S. Kobayashi</i> 4979	B	alate	60
Japan, the Ryukyus: Mt. Yuwan-dake, Naze-shi, Amami Is.	<i>G. Kokubugata</i> 6948	C	alate	60
Mt. Amagi-dake, Amagi-cho, Tokuno-shima Is.	<i>G. Kokubugata</i> 5540	D	alate	60
Mt. Gina-yama, Tokuno-shima Is.	<i>G. Kokubugata</i> & <i>K. Nakamura</i> 6949	E	alate	60
Akirigami-gawa, Tokuno-shima Is.	<i>G. Kokubugata</i> & <i>K. Nakamura</i> 6950	F	alate	60
Sueyoshi Park, Naha, Okinawa Is.	<i>G. Kokubugata</i> & <i>K. Nakamura</i> 6906	G	alate	60
Yasura, Ishigaki Is.	<i>G. Kokubugata</i> 1066	H	alate	60
Ogan-zaki, Ishigaki Is.	<i>G. Kokubugata</i> 6782	I	alate	60
Shirahama, Iriomote Is.	<i>G. Kokubugata</i> 6774	J	alate	60
Taisho-ike, Ohtomi, Iriomote Is.	<i>G. Kokubugata</i> 6763	K	alate	60
Taiwan, Taipei: Manyuehyuan Forest Park, Sanhsia	<i>G. Kokubugata</i> 3990	L	terete	30
Taiwan, Hsinchu: Mt. Litou-shan, Chienshih	<i>G. Kokubugata</i> 4947	M	terete	30
Ssumassu	<i>Lin</i> 275	N	terete	30
Taiwan, Ilan: Yuanyang Lake	<i>G. Kokubugata</i> 3927	O	terete	30

¹ *S. Kobayashi* 4979 is at MBK; *Lin* 275 at HAST; otherwise at TNS.

Results and Discussion

Morphological characters

Habits of the fifteen accessions from Japan and Taiwan were similar each other, being erect at upper part and slightly creeping at lower (Fig. 2, left). They commonly had alternate, oblong-ovate to elliptic leaves. Their corollas were also similar, being yellowish, actinomorphic, tubular, and 5-lobed (Fig. 2, right).

On the contrary, a remarkable difference was recognized in their stem morphologies: 11 accessions collected from Japan have alate stems (Table 1; Fig. 3, left, arrows), while the stems of four accessions from Taiwan are terete (Table 1; Fig. 3, right). Regarding the stem morphology, such difference was also observed among the 164 herbarium specimens.

Chromosome number

The chromosome number of the 11 accessions from Japan was $2n=60$ (Table 1; Fig. 4A–K). It agreed well with those of the plants collected in Japan at Kashima, Ehime (Jinno, 1956) and at Yakushima Is., the Ryukyus (Tanaka & Hizume, 1978). On the other hand, the four accessions from Taiwan had the chromosome number of $2n=30$ (Table 1; Fig. 4L–O).

Taxonomic conclusions

As mentioned above, the 15 accessions investigated in this study can clearly be classified into two groups by the differences of the stem morphology and the chromosome number. First group consists of 11 accessions from Japan. They have the alate stems and the chromosome number of $2n=60$. Second group includes four accessions from Taiwan. Their stems are terete and the

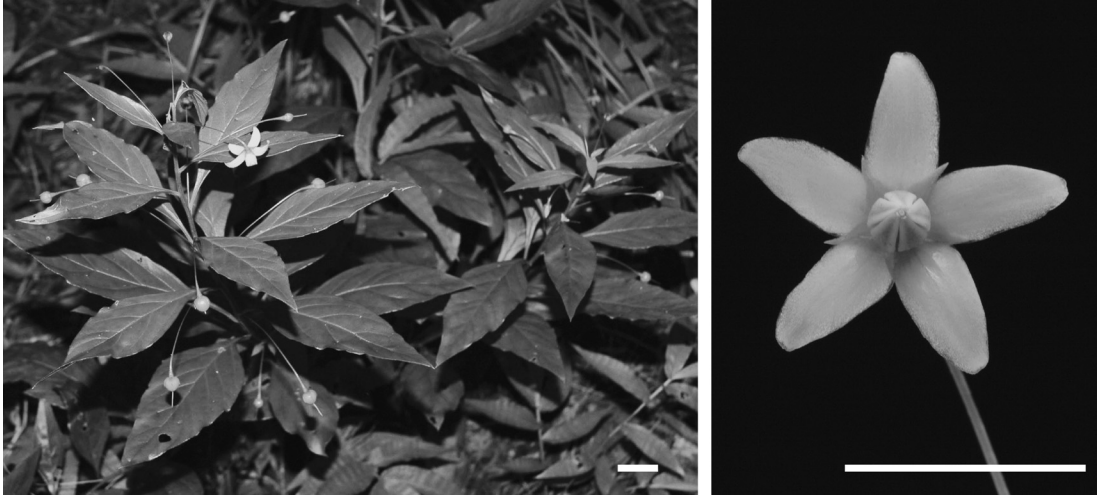


Fig. 2. Habitat of *Lysimachia sikokiana* and its flower (right) (Kokubugata 6782) in Ogan-zaki, Ishigaki Is., the Ryukyus, Japan. Scale bars: 1cm.

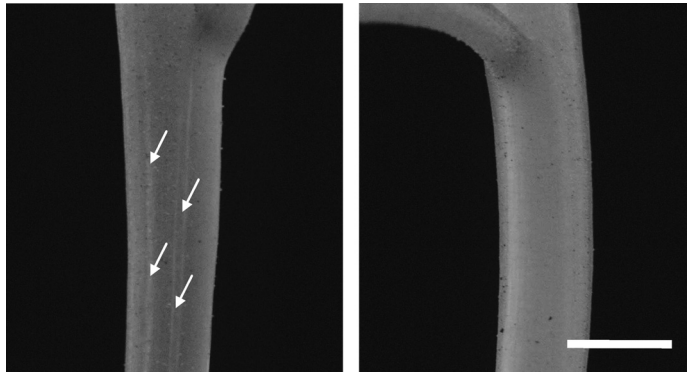


Fig. 3. Stems of *Lysimachia sikokiana* from Japan (left; G. Kokubugata 6782, Ogan-zaki, Ishigaki Is., the Ryukyus) and “*L. ardisioides*” from Taiwan (right; G. Kokubugata 3990, Manyuehyuan, Taipei). Arrows indicate wings on the stem. Scale bar: 3 mm.

chromosome number is $2n=30$. The stem morphology agrees with the original descriptions of *Lysimachia sikokiana* (Miquel, 1867) and *L. ardisioides* (Masamune, 1932), respectively. These differences can be considered to support sufficiently the taxonomical independency of “*L. ardisioides*” from *L. sikokiana*.

In our conclusion, *Lysimachia ardisioides* known only from Taiwan is a different species from *L. sikokiana* and the latter species could not be distributed in Taiwan.

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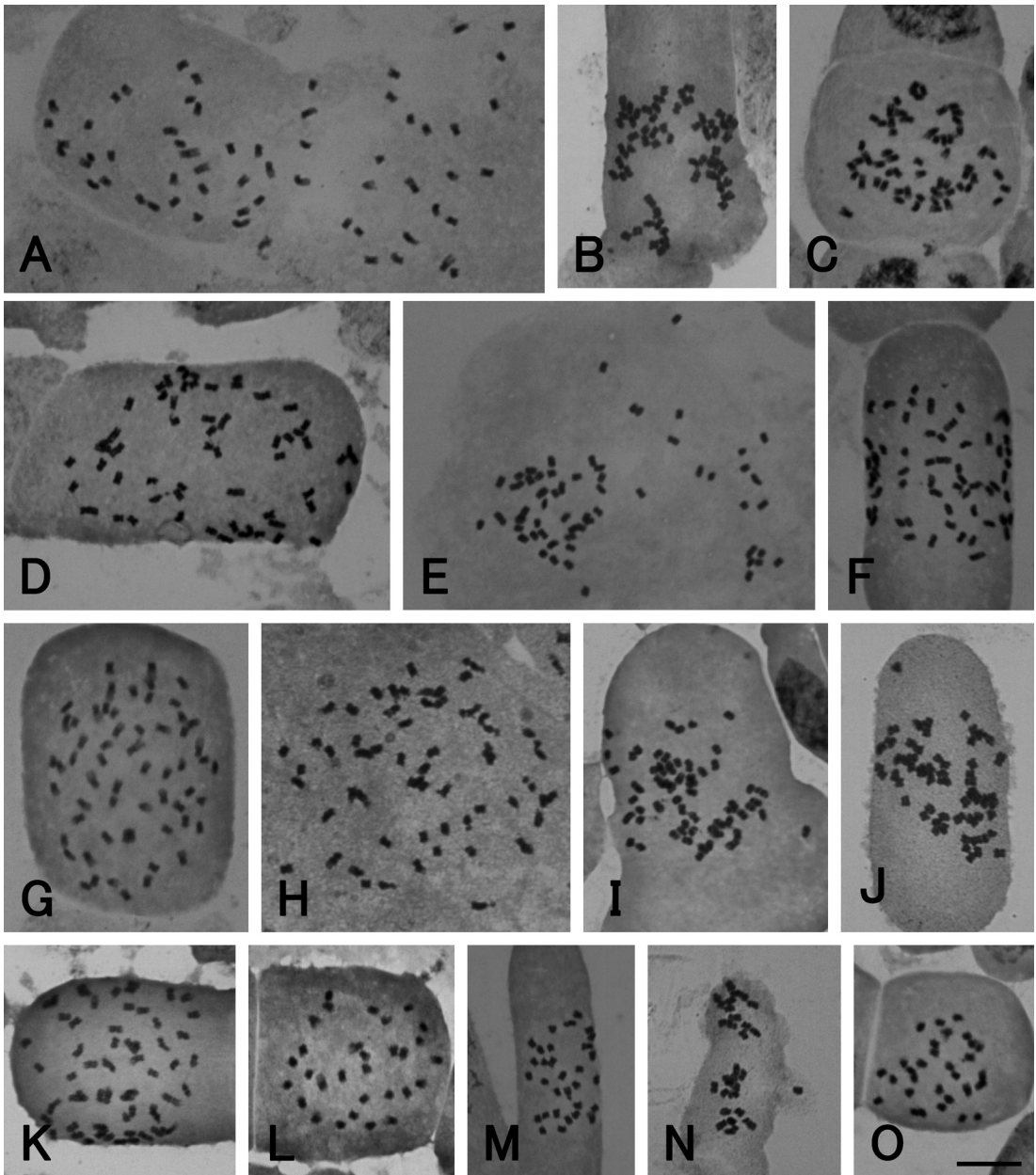


Fig. 4. Somatic chromosomes of 15 accessions. Alphabetical codes correspond to those in Table 1. Scale bar: 10 μm .

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台湾産コウジモロコシ（サクラソウ科）の分類学的再検討

國府方吾郎・彭 鏡毅・齊藤由紀子・横田昌嗣・小林史郎

台湾産の基準標本をもとに記載されたコウジモロコシ *Lysimachia ardisioides* の分類学的な取り扱いに関しては、日本に産するモロコシソウ *L. sikokiana* と同種だとする説と別種だとする説があった。この問題を解決するため、日本産11個体と台湾産4個体を用いて、外部形態と染色体数の比較を行った。その結果、日本産11個体の茎は有翼で染色体数は $2n = 60$ であり、台湾産4個体の茎は無翼で染色体数は $2n = 30$ であることが分かった。今回の結果は、それぞれを別種とし、前者をモロコシソウ、後者をコウジモロコシとする正宗(1932)の見解と一致した。