

Hideaki OHBA*: **Notes on the allied species of
Sedum Alfredii Hance from Taiwan****

大場秀章*: 台湾産シナマンネングサ群の検討**

Taiwan is situated in the eastern margin of the range of the Asiatic Sedoideae. Only two genera, *Hylotelephium* and *Sedum*, are distributed in Taiwan, and the *Sedum* shows a remarkable diversity and variation externally. Even though Liu & Chung (1977) published a comprehensive Sedoideae flora of Taiwan, our knowledge is still insufficient. In connection with a revisional study of the Asiatic species (Ohba 1980-82), the preliminary study of the allies of *Sedum Alfredii* Hance was undertaken based on the literature and herbarium specimens.

1) *Sedum Alfredii* Hance and *S. formosanum* N.E. Brown.

Liu & Chung reduced *S. formosanum* N.E. Brown in the synonymy of *S. Alfredii* Hance without any comment. Actually *S. formosanum* comes near to *S. Alfredii* in having spurred free sepals and basally connate petals of subulate or lanceolate shape, but is specifically well distinguished from that by the different appearance in several significant characters as shown in Tab. 1.

S. formosanum, described from Taiwan, is limited in the region from S. Kyushu (Japan) to Batan island (the Philippines) through Ryukyu and Taiwan, while *S. Alfredii*, described from Kwangtung, has been reported from various localities in China, Taiwan, Ryukyu and also Japan proper. Maximowicz (1883) and Yamamoto (1926) reported this from Taiwan with the citation of specimens. The specimens cited by Yamamoto are not identical with the type of *S. Alfredii* at all and seem to represent some extreme forms of *S. actinocarpum* Yamamoto or even an undescribed species. Maximowicz gave an amplification to *S. Alfredii*, but his circumscription is now regarded as a mixture of *S. Alfredii* itself and some other species as *S. Makinoi* Maxim. Although I could not examine the

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Tab. 1. Comparison among the species in *Sedum Alfredii* group.

| | <i>S. Alfredii</i> | <i>S. formosanum</i> | <i>S. actinocarpum</i> | <i>S. erythrospermum</i> |
|--|---|---|--|---|
| Carpel when matured | horizontal or oblique | erect | horizontal or oblique | oblique |
| Petal length (mm) | 4-4.5(-5) | 5-6 | 3.5-4.5 | 3.5-4.5 |
| Size of bracts | gradually smaller toward the apices of branches | gradually smaller toward the apices of branches | smaller bracts mixed with larger ones in any portion | gradually smaller toward the apices of branches |
| Thickness of flowering stem near the base (mm) | 3-4 | 5-6 | 2-2.5 | 1.5-2 |
| Axial sterile branches at flowering period | 1-2 | 0 or 1 | 0 | 0 |
| Cauline leaves | spathulate in any portions | spathulate or oblong-spathulate in any portions | spathulate in any portions | very narrowly oblanceolate or linear-spathulate; narrower than the spathulate basal leaves and bracts |
| Distribution | E. China | S. Japan, Taiwan, Batan | Taiwan | Taiwan, Luzon |

specimens cited by Maximowicz, the occurrence of *S. Alfredii* in Taiwan is thought to be a misjudgement.

S. formosanum has a tendency to grow on the bases of coastal cliff or banks as well as crevices of coral rocks on seaboard.

2) *Sedum actinocarpum* Yamamoto and *S. erythrospermum* Hayata.

Sedum actinocarpum Yamamoto resembles strongly *S. Makinoi* Maxim. from Japan, but it greatly differs from that in having spurred free sepals. By this feature and the basally connated petals *S. actinocarpum* appears to belong to the *S. Alfredii* group. From *S. Alfredii* this species is distinguished by the larger inflorescences with bracts irregular in size and the linear nectar scales. *S. formosanum* is closely related to *S. actinocarpum*, but has different appearances in several characters as shown in Tab. 1.

S. erythrospermum Hayata, described based on a single collection from Monte Morrison by Mori, resembles *S. subtile* Miq. from Japan, but as in the case of *S. actinocarpum* it greatly differs from that and also belongs to the *S. Alfredii*

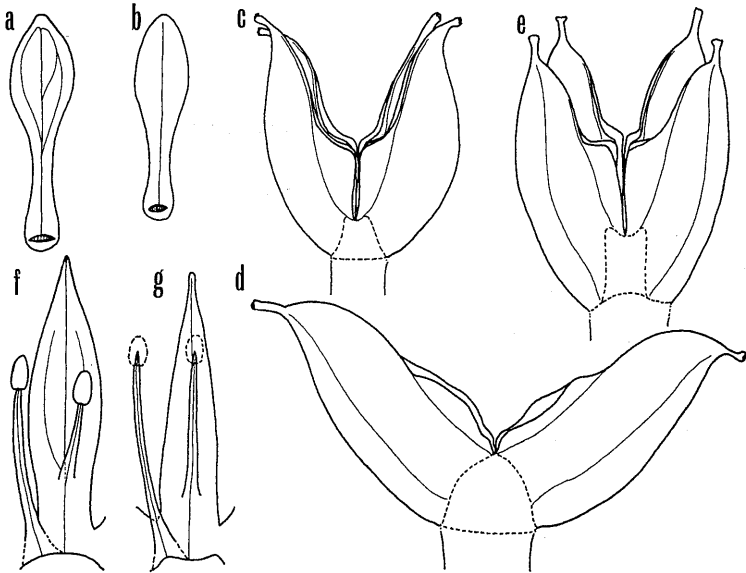


Fig. 1. Flowers of *Sedum actinocarpum* (a, c, d, f) and *S. erythrospermum* (b, e, g). a & b. sepal. c & e: pistils. d. follicles. f & g: petal with stamens. All $\times 10$.

group in having spurred free sepals and basally connated petals. The closest species of *S. erythrospermum* is apparently *S. actinocarpum*; particularly in the significant floral characters these two species show common appearance (Fig. 1). In *S. erythrospermum* the leaves of the flowering stems are very narrowly oblanceolate or linear spatulate and apparently narrower than those of the basal portion of the flowering stems and the bracts, while in *S. actinocarpum* the leaves and bracts are spatulate in all portions. The bracts of *S. actinocarpum*, however, do not gradually reduce the size toward the apices of branches, and the size of bracts is conspicuously irregular. The bracts of *S. erythrospermum* gradually reduce the size toward the apices.

The range of both species seems to be different (Fig. 2). *S. actinocarpum* is endemic to Taiwan and distributed in the east and north-east sides of the central chain of mountains, while *S. erythrospermum* is disjunctively distributed in Taiwan and Luzon (the Philippines) (Ohba 1977) and occurs in the higher elevations of the central chain in Taiwan.

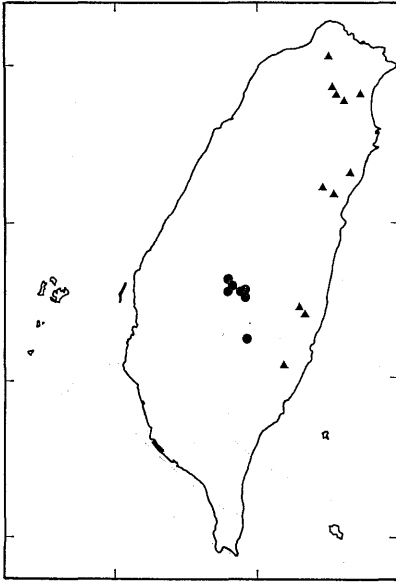


Fig. 2. Distribution of *Sedum actinocarpum* (▲) and *S. erythrospermum* (●) in Taiwan.

S. microsepalum Hayata was described from Monte Morrison based on a single collection by Kawakami and Mori. This seems to be similar to *S. erythrospermum*, but the detail is hardly recognized from the description given by Hayata. The type specimen is unfortunately not seen in TI. Liu & Chung considered *S. microsepalum* to be conspecific with *S. parvisepalum* Yamamoto. *S. parvisepalum* has basally connate sepals and seems to be clearly distinct from *S. microsepalum*.

S. arisanense Yamamoto which is also described on a single collection from Mt. Alishan or Arisan can be thought to fall in the variation range of *S. erythrospermum*.

Liu & Chung regarded *Sedum*

brachyrhinchum Yamamoto as a synonym of *S. erythrospermum*. *S. brachyrhinchum* is, however, different from *S. erythrospermum* in having long creeping flowering stems with monomorphous leaves and longer petals attaining 7 to 8 mm long.

3) A comment on the phylogenetic relationship among the *S. Alfredii* group.

There are two types in the distribution patterns of the species groups in the Asiatic *Sedum*. One is the 'Japono-Himalayan' and the other is the 'Taiwan-Philippine' type. The most of the species groups may be attributed to the former and only two groups, *S. Alfredii* group and *S. parvisepalum* group, belong to the latter. The formation of the 'Taiwan-Philippine' type is thought to be more derivative than that of the 'Japono-Himalayan' type. The formation of the 'Taiwan-Philippine' type is thought to come to the same period as the formation of the disjunctive distribution of *Sedum Susannae* R.-Hamet (Ohba 1982) and *Rhodiola chrysanthemifolia* (Lév.) Fu (Ohba 1981) and also two vicarious species at Mt. Victoria in tropical Burma (Ohba 1981).

A hypothesis will attribute to find out the phylogenetic relationship among the *S. Alfredii* group. Supposed diversification even at specific level results from climatic fluctuation between cooling and subsequent warming and also each species prasinomically may or may not divide into two sister species during a climatic fluctuation. On this supposition, if the ancestral species of a species group has met 'n' times of climatic fluctuation, the total number of species produced are 2^n in maximum (Fig. 3A).

In the *S. Alfredii* group the latest fluctuation is considered to influence to the allopatric differentiation in *S. erythrospermum* in Taiwan (subsp. *erythrospermum*) and in Luzon (subsp. *australe* (Merrill) H. Ohba) owing to the localized environmental conditions. The difference between *S. erythrospermum* and *S. actinocarpum* is apparently greater than that between the subspecies of the former. The magnitude of the difference indicates that the speciation between these two species associates with the preceding fluctuation(s). The magnitude of the difference among the species is the greatest between *S. Alfredii* and *S. formosanum*. In conclusion on this supposition the phylogenetic relationship can be drawn as in Fig. 3B. The comparison between A and B in Fig. 3 may suggest the presence of numerous species which are extinct or now not recognized.

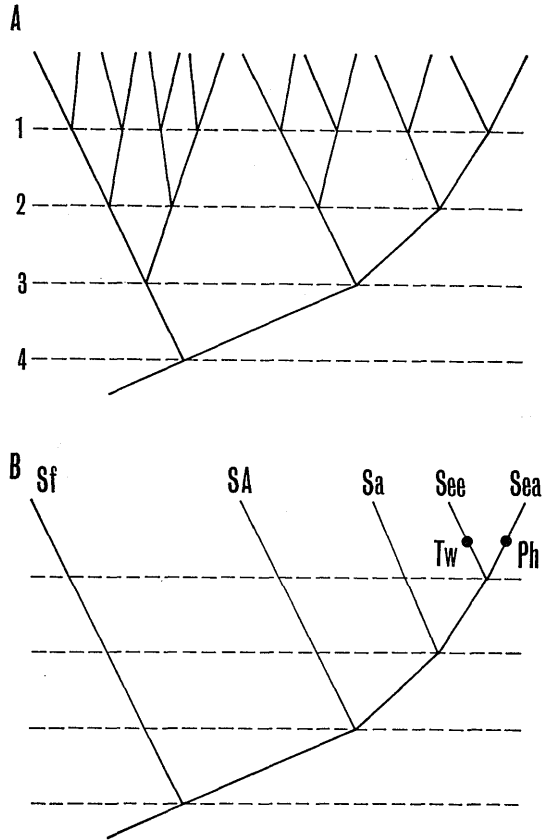


Fig. 3. A. A cladogram to show each species prasinomically dividing into two sister species during a climatic fluctuation. B. Hypothetical phylogeny among *Sedum Alfredii* group. Sf: *Sedum formosanum*. SA: *S. Alfredii*. Sa: *S. actinocar-pum*. See: *S. erythrospermum* subsp. *erythrospermum*. Sea: *S. erythrosper-mum* subsp. *australe*. Tw: Taiwan. Ph: Philippines.

4) Systematic treatment.

Sedum formosanum N.E. Brown in Gard. Chron. N.S. 24: 134 (1885)—Hayata, Icon. Pl. Formos. 2: 12 (1912)—H. Ohba in Journ. Jap. Bot. 52: 322 (1977), with further literature and synonyms.

“*Sedum Alfredii* Hance”—Maxim. in Bull. Acad. Sci. St.-Petersb. 29: 152 (1883), versim. pro parte—Liu & Chung in Li et al., Fl. Taiwan 3: 16 (1977), excl. ‘mainland China’ in distr.

Specimens examined from Taiwan. Sine loc. specialit. (Brown (ex Hort. Kew. colit.) s. n., κ -Holotype of *S. formosanum*; Wilford 623, κ -Syntype; Makino s. n., MAK); Tamsuy (Oldham 112, κ); Isl. Botel-Tobago (Hayata s. n., τ_1 ; Ikeda 2201, KAG); Pref. Pingtung, Kentin Park of Taiwan Forestry Inst. On coral limestone (Shimizu 12081, τ_1); Sekimon (Kimura s. n., τ_1); Tanoh (Hayata s. n., τ_1); Bokeikyo (Kawakami & Mori 2783, τ_1); Kelung (Nagasawa 355, τ_1).

Distr. S. Kyushu, Ryukyu, Taiwan and Batan island.

Sedum actinocarpum Yamamoto, Suppl. Icon. Pl. Formos. 2: 17, Fig. 11 (1926)—Liu & Chung in Li et al., Fl. Taiwan 3: 16 (1977).

Specimens examined. Taipei Hsien. Bunzan-gun, Agyoku (=Ayu) (Ohwi 528, $\kappa\gamma\theta$); Agyoku-Urai (=Wulai) (Ohwi 735, $\kappa\gamma\theta$); inter Shinjo-Batakan (Hayata s. n., τ_1 —Lectotype); Urai (=Wulai) (Faurie 556, τ_1 —Syntype; $\kappa\gamma\theta$ —Isosyntype); loc. cit. (Jotani 2770, TUA¹⁾); Yangmingshan (Jotani 2761, TUA); Ching-shanchiao (Inoue s. n., TUA 11178). Ilam. Tachiao-chi (Yoshizawa s. n., TUA). Hualien. Tamazato-gun (Yuli), between Warabi and Koma (Tagawa 3703, $\kappa\gamma\theta$; τ_1); Taroko inter Batakan et Tabito (Tatewaki & Kitamura s. n., $\kappa\gamma\theta$); around Mt. Chinshui. Crevices in limestone under the forest (Shimizu 12427, $\kappa\gamma\theta$); Tailuko (Jotani 2763, TUA); Tienhsiang (Kinuta 2762, 2767, TUA); Antung-wenchuan (Masuda 2772, 2773, TUA). Taitung. Kwanzan-gun (=Kuanshan), between Tatibana and Kotobuki (Tagawa 3261, $\kappa\gamma\theta$).

Distr. Endemic to Taiwan.

Sedum erythrospermum Hayata, Icon. Pl. Formos. 3: 110 (1913)—Liu & Chung in Li et al., Fl. Taiwan 3: 17 (1977), pro parte, excl. *S. brachyrhynchum* Yamamoto in syn.—H. Ohba in Journ. Jap. Bot. 52: 322 (1977).

Sedum arisanense Yamamoto, Suppl. Icon. Pl. Formos. 2: 19, Fig. 12 (1926).

Specimens examined. Taichung, between Pianan Anbu and Shikayo-sha (Ohwi 2761, $\kappa\gamma\theta$); Kao Hsiung, Kizan-gun, Kwanzangoe (Okamoto s. n., $\kappa\gamma\theta$); Mt. Arisan (Enomoto ex cult. 124, τ_1); Tai-Nan [sic] in mont. Arisan, alt. 2500 m (Faurie 555, τ_1 —Holotype of *S. arisanense*; $\kappa\gamma\theta$ —Isotype); Nantou, Tungpu—Yushan (Mizushima s. n., τ_1); Nantou, Yushan, Tataka-Paiyunshanchang, alt. 3100 m. In shady *Tsuga*-forest. Fls. yellow (Yamazaki & Yamazaki 836, τ_1). Hsishang—Paiyunshanchuang (Iwasaki 1944, TUA); Alishan—Tungpu (Iwasaki 1952, TUA); Nantou, Tuntou, (Masuda 163, Nakamura 162, TUA); Tungpu—

1) The Herbarium, Tokyo University of Agriculture, Setagaya, Tokyo.

Totochieh (Matumoto 1948, TUA); Monte Morrison (=Mt. Yushan) (Mori s. n., T1—Holotype of *S. erythrospermum* Hayata); loc. cit., alt. 3500 m. Fl. yellow (Steenis 20948, L); Chiai, Lulinshan (Inoue 1953, TUA).

Distr. Taiwan and Luzon (subsp. *australe*).

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中国広東から記載された *Sedum Alfredii* Hance (シナマンネングサ) に近縁な種は、九州からフィリピン・バタン島にかけて分布するハママンネングサのほか、台湾に2種産する。最新の台湾植物誌で劉・鍾はハママンネングサをシナマンネングサの異名としたが、両種は明らかに異なる。果実期においても直立する心皮をもつのはハママンネングサのよい特徴である。Maximowicz や Yamamoto によってシナマンネングサそのものが台湾に産するとされたが誤りである。ホンザキマンネングサ (*Sedum actinocarpum* Yamamoto) はマルバマンネングサによく似てみえるが、萼片が基部で合着せず基本的に異なる。シナマンネングサに最も近い種と考えられる。アカダマンネングサ (アリサンマンネングサ *Sedum erythrospermum* Hayata) はヒメレンゲに似てみえるが、基部で合着した披針形あるいは鍼形の花弁を有し、ヒメレンゲとの関係は考えられない。アカダマンネングサは結局のところホンザキマンネングサに最も近く、花の重要な形質での差はみられない。ホンザキマンネングサや他のシナマンネングサ群の種から本種を区別するよい特徴は、花茎に着く葉がヒメレンゲのように基部に着く葉や苞葉よりも幅狭く、狭倒披針形あるいは線状さじ形になる点である。ホンザキマンネングサが台湾特産で中央山脈の東側や東北側の割合低い地域に分布するのに対して、アカダマンネングサはフィリピンに亜種を産し、台湾では玉山や阿里山などの高所に分布する。地理的分布と形態学的形質の資料にもとづいてシナマンネングサ群の4種1亜種の系統について考察を行った。