

Taxonomic study of the Sino-Himalayan species of section *sinarisaema* Nakai (*Arisaema* - Araceae)

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Summary. A study of *Sinarisaema*. from Sino-Himalayan regions and neighbouring countries is made, with a particular emphasis on the status of *A. concinnum* Schott, *A. consanguineum* Schott, *A. erubescens* (Wallich) Schott and *A. formosanum* Hayata.

The genus *Arisaema* Schott has been divided, since Engler's time (Pflanzenreich 73 [IV.23F]. 1920), in sections according to some characters. Members of section *Sinarisaema* differ markedly from all others by the radiatisect disposition of their leaflets (Fig. 1), reminding us of *Trilliaceae* as *Daiswa polyphylla* (Smith) Rafinesque. The sessile or subsessile leaflets, never less than seven, are of nearly equal-length. This peculiar radiate leaf arrangement induced Nakai to define section *Sinarisaema* (Journ. Jap. Bot. 25: 6. 1950) with *A. formosanum* as the type.

A more accurate study reveals that the symmetry of rotation with respect to the centre of the leaf, is only approximate. Actually, it may be more or less broken when the leaf is in a vertical plane, due to the action of gravity. A symmetry with respect to a plane becomes apparent (Fig. 1c), confirmed by the presence of a central leaflet which, despite the absence of a rachis, plays a special role: when leaflets unfold, they are turned downwards, wrapping up the petiole, except {this} [the] central one which, in most species, is upright. This is a reminder of the basically tripartite disposition of all *Arisaema* leaves whose central foliole is surrounded by more or less numerous laterals arranged along a rachis.

Fig. 1. Various leaves in section *Sinarisaema*

According to J. Murata (Bot. Mag. Tokyo 103: 371. 1990), *Sinarisaemas* have a quincuncial phyllotaxy, like all species of section *Pedatisecta* (Schott). At the exception of some members of section *Fimbriata* (Engl.), a section which probably needs revision, all other *arisaemas* have a spirodistichous leaf arrangement.

Sinarisaema are found in many regions, with various climates, temperate to tropical. Species from Africa, South India, Vietnam and Philippines have not been considered here and, in what follows, essentially Sino-Himalayan *Sinarisaema* have been retained.

However one species, *A. consanguineum* seems obviously most widespread in Asia: its distribution extends from Uttar Pradesh to Continental China but is also present more in the South, in Meghalaya, Thailand, Hong-Kong and Taiwan. For this reason, two related species, from Taiwan,

are also included in this study, even if this area occupies a bordering position with regard to the Sino-Himalayan countries.

Most *Sinarisaema* look like elongated plants, higher than wide, with one or two leaves and 7 to 23 leaflets. Their pseudostem, always conspicuous, varies from about half the size of the plant to very short. All *Sinarisaema* have a spadix-appendix slightly exerted from the spathe-tube {and} which bears neuters at the base, except one of them, *A. exappendiculatum* Hara, whose spadix appendage is extremely short or more often lacking.

In {this section}[the *Sinarisaema* section], the receptacle of the infructescence is cream-coloured and monoecious specimens are exceptional. As usual in botany, even in a single taxon, many characters vary and are only defined on a statistical basis. Indeed, one should expect a range of variability in characters such as the onset of dormancy, the number of leaves and leaflets, the size of various parts of the plants, the inflorescence colours, the degree of development of neuters.

Even the sessile or stipitate character of spadices, so often used in *Arisaema* descriptions is not stable. For instance, a sessile spadix-appendix, in direct continuation with the fertile part, occurs in *A. consanguineum* Schott while a conspicuously stipitate spadix-appendix is found in *A. echinatum* (Wall.) Schott. But J. Murata (Journ. Jap. Bot. Tokyo 60 (12): 353. 1985) pointed out that *A. taiwanense* J. Murata exhibits [either behavior.]{both {behaviours: some} [Some] specimens have a stipitate spadix appendage when others are sessile. Such character is irrelevant in keying out a species. With this requirement in mind, only the following dichotomous cladistic characters have been considered as satisfactory to separate the species in section *Sinarisaema* (the choice may be different for other sections):

- 1 – The species is non-stoloniferous (0) or stoloniferous (1).
- 2 – The first eophyll is simple (0) or trifoliolate (1).
- 3 – The fruiting peduncle, at maturity, is nodding (0) or erect (1).
- 4 – When the leaf unfolds, the central leaflet is turned upwards (0) or downwards (1).
- 5 – The leaflets are filiform at the apex (0) or not (1).
- 6 – The pseudostem is nearly the size of the petiole (0) or is much shorter (1).
- 7 – The spadix-appendix is present (0) or absent / extremely short (1).

On this cladistic basis, we propose the following key based on observations made on specimens in herbarium, as well as on living material in the wild and in cultivation.

KEY to Section SINARISAEMA

- 1a. Non-stoloniferous species, first eophyll simple 2
- 2a. Nodding fruiting peduncle 3
- 3a. Pseudostem nearly the size of the petiole; central leaflet turned upwards when leaf unfolding; leaflets usually with long threads at apex; distribution: Asia *A. consanguineum*

- 3b. Pseudostem much shorter than the petiole 4
- 4a. Central leaflet turned downwards when leaves unfold; leaflets usually with long threads at apex; distribution: Taiwan *A. taiwanense*
- 4b. Central leaflet turned upwards when leaf unfold; distribution: Himalaya *A. echinatum*
- 2b. Erect fruiting peduncle ; distribution: Taiwan *A. formosanum*
- 1b. Stoloniferous habit 5
- 5a. Spadix-appendix extremely short or absent, erect fruiting peduncle; distribution: Himalaya *A. exappendiculatum*
- 5b. Spadix-appendix slightly exserted from the tube 6
- 6a. First eophyll trifoliate, erect fruiting peduncle; distribution: Himalaya *A. concinnum*
- 6b. First eophyll simple, nodding fruiting peduncle; distribution: Continental China *A. ciliatum*

Some details about the inflorescence (Fig. 2), namely the tip of the spadix-appendage and the margin of the spathe-mouth, may facilitate the identification of these *Sinarisaema* species:

Fig. 2. Various inflorescences in section *Sinarisaema* :

A. consanguineum: Spadix-appendage tip thick and smooth

A. taiwanense: Spadix-appendage tip thick and spongy

A. concinnum: Spadix-appendage tip slightly thickened, sometimes bent down

A. formosanum: Spadix-appendage tip less than 1.5 mm, often bent down

A. ciliatum: More or less ciliate spathe-mouth & spiny spadix-appendage tip

A. echinatum: Spadix-appendage tip covered with fine and short hairs *

A. consanguineum Schott (Bonplandia 7: 27. 1859) Although variable in size and number of leaflets, this species is easily recognisable: a medium to tall stem carry one or two umbrellas with thread-like drooping tips, its typical inflorescence with a 10-15 mm cylindrical to club-shaped green spadix and a long-tailed spathe-limb conspicuously wider than the tube often flushed brown outside.

In cultivation, we observed a staggered onset of emergence for specimens coming from a range of collection sites (February to June). This species was cited and described under various names now considered as synonyms such as *A. filamentosum* nom. nud. (Wall. Cat. 1155), *A. fraternum* Schott (Bonplandia 7: 26. 1859), *A. tatarinowii* Schott (Bonplandia 7: 27. 1859) & *A. vituperatum* Schott

(Bonplandia 7: 28. 1859), *A. erubescens* var. *consanguineum* (Schott) Engl. (D.C. Mon. Phan. 2: 558. 1879), *A. davidianum* Engl. (Engler's Jahrb. 25: 27. 1898), *A. consanguineum* var. *davidianum* Engl. (Pflanzenr. 73 [IV.23F]: 177. 1920), *A. consanguineum* f. *latisectum* Engl. (Engler's Jahrb. 29: 236. 1901), *A. giraldui* Baroni (Bull. R. Soc. Toscanaortic. 12. 1893).

The following species, from Thailand, are related and perhaps synonymous with *A. consanguineum*: *A. hypoglaucom* Craib (Kew. Bull. 418. 1912), *A. kerrii* Craib (l.c.), *A. kerrii* Gagnep. (Not. Syst. 9: 125. 1941) and *A. sukotaiense* Gagnep. (Not. Syst. 9: 129. 1941).

In Taiwan, adult specimens of *A. consanguineum* have the typical inflorescences usually with two leaves when elsewhere they are more often one-leaved. In his systematic study of Taiwanese *Arisaema*, J.C. Wang (Bot. Bull. Acad. Sin. 37: 61. 1996) gives some synonyms referring to plants collected on Taiwan, *A. kelung-insularis* Hayata (Icon. Pl. Formos. 5: 246. 1915), *A. biradiatifoliatum* Kitamura (Acta Phytotax. Geobot. 10: 187. 1941), *A. consanguineum* var. *kelung-insularis* (Hayata) Huang (Taiwania 7: 102. 1960). In the key, no explicit mention is made of *A. erubescens* (Wallich) Schott. This species was found in Nepal and first described as *Arum erubescens* Wall. (Plantae Asiaticae Rariores, p. 30. 1831). It is amazing to note that all living material of *Sinarisaema* introduced today from C Himalaya (Darjeeling, Nepal, Sikkim ...), {**behalf the well-known and unquestionable**}

[not sure what you meant. perhaps **claimed to be**]

A. echinatum, always correspond[s] to either *A. concinnum* or *A. consanguineum*. Moreover, when plants are introduced as *A. erubescens*, they are nothing but a more or less reddish spathed *A. concinnum*.

Indeed the very status of *A. erubescens* is a much debated question, some botanists even claiming that this species is identical to *A. consanguineum*. It was thus necessary to go back to Wallich's original documents: the colour plate which illustrates Wallich's description (Plantae Asiaticae Rariores, tab. 135. 1831) and pressed specimens.

The National Botanic Garden of Belgium has Wallich's book in its library and many dried specimens from Wallich's collection in its Herbarium. After a careful study of these, it became obvious that *A. erubescens* was stoloniferous and hence had no relations with *A. consanguineum* but was identical to *A. concinnum*: The gist of our argument is that Wallich's colour plate explicitly shows the presence of a nascent stolon at the base of the tuber while, at the same time, the leaf and the shape of the inflorescence {**recalls us**} [**reminds us of**] *A. concinnum*.

On the other hand, the herbarium plate 1736 labelled "Arisaema Nepalia Wall. 1821. Wall List 8917", which corresponds to the type of *A. erubescens*; contains two similar specimens; by chance, one of them is pressed with its tuber and a stolon is present.

{**note the too frequent use of "On the other hand"**}

{**On the other hand**, t}[**T**]he three herbarium plates 1735 labelled "Arisaema Nepalia Wall. 1821. Wall List n=B0 8915" relate to specimens without tubers, but one of them has leaves whose tips end in the typical *A. consanguineum* thread and note that Wallich 8915 will eventually be used pro parte later by Schott to describe *A. consanguineum*. A detailed study of this peculiar problem will appear elsewhere (to be published in SHPA). *

A. taiwanense J. Murata (Journ. Jap. Bot. 60: 353. 1985)

The thin filiform tips of the leaflets of *A. taiwanense* remind us of *A. consanguineum*; both species have threads in the continuation of the leaflets (Fig. 1b) whose length vary in a continuous way, sometimes up to 40 cm long but usually much smaller values are observed. Consequently, when out of flower, they can be easily mistaken for the other. It is probably for this reason, that Hayata did not recognised *A. taiwanense* as a new species when working on his inventory of the flora of Taiwan (Icon. Pl. Formos. 5: 241. 1915). One had to wait until 1985, when J. Murata visited Taiwan and had the opportunity to observe flowering populations in the woods near Alishan. He discovered the presence of a new species, *A. taiwanense* with {his}[its] green coloured tuber and pinkish woody roots (Journ. Jap. Bot. 60: 353. 1985). When in flower, the purplish-red spathe and rugose spadix-appendix tip does not allow us to make a wrong identification. As in *A. echinatum*, the peduncle is short and the fruiting spike often lies on the ground. Some populations, from southern and eastern parts of Taiwan, have so short a peduncle that they have been described as *A. taiwanense* var. *brevipedunculatum* J. Murata (Ibid.). *

A. echinatum Schott (Bonplandia 7: 27. 1859)

This non stoloniferous species looks like a small sized *A. concinnum* but its pseudostem is so short that the fruiting spike often lies on the ground, a character that it shares with the former species. When in flower, *A. echinatum* is very easy to identify, its distinctly stipitate spadix-appendage ends in a small green or purple head, covered with short and white hairs, a unique feature among *Sinarisaema*.

A. formosanum Hayata (Icon. Pl. Form 5: 243. 1915, as *A. formosana*)

A. formosanum has always been described with a spadix-appendix whose apex is very thin, less than 1.5 mm wide and more or less recurved; flowering specimens are usually encountered with one leaf only. We had the opportunity to come across a population near Funchiko, whose specimens perfectly matched the original Hayata's description and we observed, {maybe} [perhaps] for the first time, that the fruiting peduncles remain erect, like those of *A. concinnum* and *A. exappendiculatum*, until all the plant withers. In e.g. *A. consanguineum* and *A. ciliatum*, the peduncle becomes dependent even well before the spathe is fading.

On the other hand, in many other localities in Taiwan an anomalous variability is present in *A. formosanum*-like populations: the tips of the spadix-appendices vary from extremely thin to quite thick, the peduncles are short to long, compared to the petioles, the spathe-limbs are more or less caudate. For all these reasons, it has been suggested by J.C. Wang (loc. cit.) that this variability could be the result of a natural hybridisation between *A. formosanum* and *A. consanguineum* which often are growing side by side in the same locality. {In cultivation also, observations of the existing variation range, made in a lot of specimens grown from wild collected seeds, second} [Observations of many specimens grown from wild collected seeds also support] Wang's hypothesis. When looking at the leaves, the similarity between *A. formosanum* and *A. concinnum* is perhaps at the origin of the first description of the species as *A. alienatum* var. *formosanum* (Schott) Hayata (Mater. Fl. Formos. 8: 371. 1911), i.e. a variety of *A. alienatum* Schott, today considered synonymous with *A. concinnum*. J.C. Wang (loc. cit.) gives also as synonyms: *A. formosanum* form. *stenophyllum* Hayata (Icon. Pl. Form. 5: 244. 1915) used to describe specimens with very narrow leaflets, *A.*

oblanceolatum a name given by Kitamura (Acta Phytotax. Geobot. 10: 188. 1941) to specimens with purple inflorescences (the typical plant of Hayata has a green inflorescence) and *A. formosanum* var. *bicolorifolium* a variegated form recently discovered by Huang (Taiwania 27: 30. 1982).

A. exappendiculatum Hara (Journ. Jap. Bot. 40: 21. 1965)

A. exappendiculatum and *A. concinnum* seem close to each other. Nearly identical in size and foliage, well grown specimens produce stolons bearing small brown scaly tubers at their tips. Plants with two leaves are not exceptional and some forms have petiole ornate with typical longitudinal chocolate-brown stripes. The spadix-appendage of *A. exappendiculatum* is usually completely lacking (Fig. 3). The involute spathe-limb has overlapping margins, giving the impression that the erect spathe is closed up. The male flowers of *A. exappendiculatum* with their strongly fused ring-like anthers resemble suckers borne on octopus tentacle.

Fig. 3. *A. exappendiculatum*

A. concinnum Schott (Bonplandia 7: 27. 1859)

Various forms of *A. concinnum* {in are come across}[appear] in the wild. But despite its variable size, the species is easy to identify through its leaflets with impressed veins on the upperside but without threads at apex. The spathe-limb is scarcely wider than the narrow tube and the spadix-appendix has a somewhat broader tip, knobbly or crumpled, green {and / or} [and/or] purple. The size of some specimens in Siang District (Arunachal Pradesh, India) can be quite impressive while smaller specimens are found in Meghalaya or Darjeeling. Above all, it can be characterised by its stoloniferous tuber and a fruiting peduncle which always remains erect.

A. ciliatum H. Li (Acta Phytotax. Sin. 15: 108. 1977)

H. Li describes a plant distributed in Yunnan, with a purple-coloured spathe differing from *A. consanguineum* (*A. erubescens* in the text) by a purple limb with green stripes ending in an anastomosis near the margin. Of course, the name *ciliatum* is reminiscent of a specific character for this species, the presence of cilia on the tube mouth. However, one has to [concede that] {precise that} sometimes the cilia on the mouth of the spathe "are best seen with a hand lens", as written by R. McBeath (Quart. Bull. of the Alpine Garden Society 64(2): 185. 1996). Amazingly, H. Li does not mention what is, maybe one of the most distinguishing characters of the species in section *Sinarisaema* : it is stoloniferous. Hence, it is easy to separate it from its relatives, such as *A. consanguineum* and *A. echinatum* which also grow in this part of China. With regard to the colour of the inflorescence, this species is [variable,] like, most arisaemas, {variable,} with a green or purplish prevailing colour.

In 1992, we were offered wild collected seeds by the Shanghai Botanic Garden from Mt. Emei (Sichuan) as *A. consanguineum*. When flowering, it appeared that these and the Yunnanese *A. ciliatum* shared so many features (same vivid coloured inflorescence, ciliate tube mouth, spiny spadix-appendix apex, same fruiting spike and berries) that we suggested they were the same species. Descriptive notes and colour prints were mailed to the Botanical Garden of Kunming who kindly confirmed our tentative identification. This wider distribution has also recently been reconfirmed by the Alpine Garden Society Expedition to China 1994 (known under its acronym ACE)

which also came across specimens of *A. ciliatum* in N Sichuan. In 1988, C.D. Brickell and A.C. Leslie collected {in China} a form of *A. ciliatum* [in China] whose spiny spadix-appendage tips are particularly impressive as it appears on plants cultivated in the Royal Botanic Garden of Edinburgh. A rather similar plant, introduced in the trade as *Arisaema* 'CT 369', has been collected close to Liuba (Sichuan), in September 1991, by Carla Teune ({of the} University of Leiden Botanic Garden). It {too} now appears to be {also} a stoloniferous plant, with a purple and white spathe and a cylindrical spadix-appendage, well-exserted from the tube, whose tip is slightly irregular but without spines. Despite the absence of conspicuous cilia and spiny spadix-appendix tips, this type of plant{s} is close to *A. ciliatum* and could [easily] be all the more described as a variety. Indeed, near Lijiang (Yunnan), specimens similar to Carla Teune's introduction are growing side by side with others which have a green ciliate spathe and a spiny spadix-appendage tip.

The {three} following [three] species are probably unknown to most Western Botanical Gardens and are not included in our key. As they are mentioned in the literature, we will give some information on them: *A. brevipes* Engl. (Bot. Jahr. 36, Beibl. 82: 11. 1905) native from Sichuan and Shaanxi, around 1000 m. Curiously among *Sinarisaema*, the peduncle is longer than the petiole, the plant looks wider than tall. It is described as a large one-leafed plant with 13 wide and acuminate leaflets. The holotype was collected with a fruiting spike, its spathe was unknown. In P.C. Kao's *Flora*, the inflorescence is described with a green tube and many more details are added. Obviously this species seems well known by Chinese botanists and we guess it will be reintroduced soon.

A. undulatum Krause (Feddes Repertorium Sp. Nov. 12: 313. 1922) is a species discovered around 2,100 m, above Dali, Yunnan and which seems to have been lost. The presence of a purple tube is mentioned, but there are no illustration[s] in Chinese floras, {nor any} [and there appears to be no] further information since Krause's time.

A. xiangchengense H. Li & A.M. Li (Acta Bot. Y. 5(1): 69-71. 1983) {on the contrary,} is a new species described quite recently from Sichuan's Hengduan Mountains, growing in oak forests, around 5,500m. Close to *A. consanguineum*, this species is tall, about 80 cm H, with long acuminate leaflets, and the foliage overtops the inflorescence. Here also the tube is green, cylindrical, white striped, but the mouth has a straight margin. The limb is narrow ending in a 6 cm L tip. The stipitate and truncate spadix-appendage is conspicuously thickened above the stipe where its diameter reaches 1 cm. It is yellowish green and slightly exserted from the tube. It flowers in August.

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