

NOTES ON THE *ARISAEMA* OF TAIWAN

by

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Natural environment plays an important role in the plant kingdom. The external morphology of plants may be more or less influenced by environmental factors. Sometimes the sex of a plant is affected. Take *Arisaema* plants for an example, these plants are quite sensitive to environmental conditions. For this reason, Dr. Nakai⁽¹³⁾ termed these plants paradioicous, which term is applied to a plant which bears female flowers only when it is well grown, and male flowers when not fully developed.

So far as the writer knows, the following botanists are the only ones who have published reports concerning the sex problem in *Arisaema*, they are Hino,⁽⁷⁾ Maekwa⁽¹¹⁾ and Schaffner.⁽¹⁴⁾

In February 1959, the writer collected some abnormal plants of *Arisaema formosana* Hay. on the Chi-Tou Tract of the Experiment Forest of the National Taiwan University. Since then close attention has been paid to this species by the writer. As a result of his field observation, several interesting phenomena have been observed:

1. Corm

It seems that there is a definite relationship existing between the sex of the plant and the size of corm. Mr. Hino's paper⁽⁷⁾ reported that corms of *Arisaema ringens* (Thunb.) Schott weighing from 8 to 53 grams bear male flowers and those weighing from 41 to 192 grams bear female flowers. According to the writer's observation on *Arisaema formosana*, the diameter of the corm of the male plant usually does not exceed 2 cm., while that of the female plant is more than 2 cm. in diameter. If the diameter of a corm of this plant is over 3 cm., it will certainly produce female flowers and have bipalmate compound leaves.

The weight and size of many corms of *Arisaema taihokensis* Hosokawa were measured. The female plants have corms weighing from 10.5 to 62 g. with an average weight of 28.70 g. and their diameter are from 2.8 to 6.2 cm. with an average diameter of 4.37 cm., while male ones weigh 2 to 20.5 g. with an average weight of 11.01 g. and their diameter is from 1 to 4 cm. with an average diameter of 2.53 cm.

2. Height of the pseudo-stem including the length of petiole

The height of the pseudo-stem of male plants of *Arisaema formosana* is less than

55 cm. and the height of female plant is over 40 cm. tall. It seems that it is safe to say that female plants including their compound bipalmate leaves are over 60 cm. tall. Last summer I was astonished to find one plant of *Arisaema consanguineum* Schott var. *kelung-insularis* (Hay.) Huang that was 2 meters tall. This very large plant was found growing among the bushes of *Pleioblastus niitakayamensis* (Hay.) Ohki on Mt. Ali. It may be considered that its tall slender stem is the result of adaptation, due to struggling for the light with bamboos. That is to say, the height of the pseudo-stem is not absolutely stable, but is rather variable. The height of the plant is related to the age of corm, but those growing on sunny slopes in full light are lower and have stouter pseudo-stems than those growing in dense shade.

The pseudo-stems of *Arisaema consanguineum* Schott forma *latisectum* (Engl.) Engl. which I have measured are from 40 to 100 cm. in height, while the male ones are measured to be from 20 to 40 cm. in height.

3. Number of leaves

The leaves of *Arisaema formosana*, *Arisaema consanguineum* var. *kelung-insularis* and *Arisaema consanguineum* forma *latisectum* have been reported as palmately compound by former botanists; however the writer has found that many have bipalmate compound leaves (see figure 1) and nearly all of them were female plants. It should be pointed out that up to the present only two male plants of *Arisaema formosana* with bipalmate compound leaves have been collected (Huang 1635, and Kawakami, T. et Sasaki, S. 5427). The female plants of *Arisaema consanguineum* forma *latisectum* with quadri-palmate compound leaves are seldom found, although the writer has collected one (see figure 6). Dr. Kitamura's remarks⁽¹⁰⁾ about the changeability of the leaves of *Arisaema grapsospadix* Hay. (see figure 2, 8 and 9) is valuable and is quoted here; He says, ".....This species varies considerably in the same locality. The leaves 1-3, usually 2, the leaf segments usually 3, sometimes 5.....". Hayata used the number of leaves per plant and number of leaflets per leaf to separate this taxon into several species, eg. plants with one leaf bearing three leaflets he called *Arisaema Matsudai*, plants with two leaves and three leaflets on each leaf he called *Arisaema grapsospadix*; plants with two leaves but bearing five leaflets at least on one leaf he termed *Arisaema quinquefolia*. I think this variability may be closely related to the age of corm. When young, the corm bears a single palmate compound leaf then as the plant grows older it bears bi-, tri- or quadri-palmate compound leaves.

4. Number and size of leaflets

The number of leaflets of many plants have been counted. This study was made mainly on *Arisaema consanguineum* forma *latisectum*. The number of leaflets of this plant increases gradually with the advance in the age of the plant. I have col-

lected this species with the following number of leaflets: 2, 3, 4, 5, 7, 8, 9, 10, 11, 12 and 13 (see figure 5). No flowering spadix has been found on young plants with as few as 2 to 5 leaflets: the female plants have from 7 to 13 leaflets, and the male ones have from 8 to 11 leaflets.

The size of leaflets (excluding the filiform tip) was observed on *Arisaema consanguineum*, var. *kelung-insularis*, *Arisaema consanguineum* forma *latisectum*, *Arisaema formosana*, *Arisaema formosana* form *stenophylla* and *Arisaema taihokensis*. The leaves with largest and smallest sizes of each specimen were selected for measurement. The results are shown in the following table.

Table 1. Table is a summary showing the relative size among the following five species. (Their size is diminished as a result of drying, so measurements on dried plants is much less than on living.)

	Length (cm.)			Width (cm.)			Number of specimens examined
	Min.	Max.	Aver.	Min.	Max.	Aver.	
male <i>A. consanguineum</i> var. <i>kelung-insularis</i>	12	13	12.5	1	1.3	1.15	1
female <i>A. consanguineum</i> var. <i>kelung-insularis</i>	10	20	16.7	2	3	2.61	5
male <i>A. consanguineum</i> forma <i>latisectum</i>	7	20.5	10.18	0.8	3	1.88	5
female <i>A. consanguineum</i> forma <i>latisectum</i>	13	37	21.23	3	10.2	5.43	22
male <i>A. formosana</i>	3.5	18.7	10.54	0.7	3.5	2.04	25
female <i>A. formosana</i>	6.5	26	16.93	1.1	5.5	3.27	25
male <i>A. formosana</i> form. <i>stenophylla</i>	7	19	15	0.3	0.6	0.53	3
female <i>A. formosana</i> form. <i>stenophylla</i>	18	22	20	0.4	0.4	0.4	1 (Type)
male <i>A. taihokensis</i>	3.5	20	10.88	1.8	12.3	5.42	39
female <i>A. taihokensis</i>	8	30	17.38	2.5	15	9	12

From the above table, we can learn the following facts:

1st. We can distinguish *Arisaema formosana* from its form plant by the width of its leaflets.

2nd. Female *Arisaema consanguineum* var. *kelung-insularis* has the same size of leaflets as the female plants of *Arisaema formosana* and male *Arisaema consanguineum* forma *latisectum* has the same size of leaflets as the male plants of *Arisaema formosana*.

3rd. In *Arisaema consanguineum* forma *latisectum*, *Arisaema formosana* and *Arisaema taihokensis*, the female plants have larger leaflets than the male ones.

5. Flowering period and reproduction methods

Both female and male plants begin to flower at about the same time. They

usually begin their flowering in early January and they continue their flowering until October. Male plants have a shorter flowering period than that of female ones. By the last of September, I only found one male plant on Mt. Ali, but there were an abundance of mature fruiting plants. Some old corms start their flowering and leaf-bearing at the same time.

Reproduction in the *Arisaema* plants, like some other plants, may be either by the asexual or the sexual method. It seems that asexual reproduction is more suitable for their propagation, since their covering spathes and the short pseudo-stem of male plants obstructs their pollination. When we dissect the basal corm, we find the young bud existing within the corm (see figure 12A, b). This young bud will bear new leaves after a period of dormancy or after a winter. There are also new corms (see figure 12A, a) produced around or on the upper side of old corms. These corms produce new separate male plants when the old corm has decayed.

6. Monoecious plant

It has been reported by Schaffner⁽¹⁴⁾ that monoecious *Arisaema* has a zone of carpellate flowers at the base of the spadix which covers about three fifths of the spadix and that the staminate zone is above the carpellate. Ten⁽¹²⁾ species of *Arisaema* have been collected on Taiwan and all ten of them were originally described as dioecious (see figure 3). Last year I collected a plant of *Arisaema formosana* (see figure 4) which was monoecious. Its leaflets were 16.5–17.5 cm. long and 3–3.2 cm. wide. The appearance of this monoecious plant resembles that of the dioecious plants. The female flowers are on the lower part of the spadix and male flowers are on the appendage. Above the staminate zone are two setose hairs. The female flowers on this plant have only one ovule, this last character makes it quite different from that of any other *Arisaema* that we have seen.

Monoecious *Arisaema taihokensis* (see figure 12) was also collected twice (Huang 1975 and 2019). The arrangement of flowers on the spadix with the male flowers on the uppermost portion, they are in one series and with distinct stamens of two anthers each; the lower portion is covered with female flowers. Likewise, *Arisaema consanguineum* var. *kelung-insularis* has been observed as a monoecious plant. This plant formerly had a female "compound spadix" (Huang 1706, see figure figure 11). It has only one thick column which is covered with setose hairs. The male flowers are also on the upper part of the spadix, they are in several series and with connate stamens of two anthers each; the lower portion is covered with female flowers and several bulbiform ovaries which are extruded from the larger ovaries.

7. Abnormal spadix

Several abnormal spadices were described by Maekaw.⁽¹¹⁾ His information was based on the studies of sex-transformation from asexual condition through male spadix

and intersexual spadix to female spadix. Biforked and triforked spadices also have been reported.

In normal female plants of *Arisama formosana*, *Arisaema consanguineum* var. *kelung-insularis* and *Arisaema consanguineum* forma *latisectum* the spadix is simple. Several abnormal types of spadices have been found. One is the "biforked spadix" (see figure 10). This term is applied to a spadix with two separate axils bearing female flowers. Sometimes the two spadices are entirely distinct, and sometimes they are united at the base. In most cases only one of the spadices has an appendage, the other lacks this structure. Maekawa's illustrations show an appendage on each fork. This type has been collected by the writer only twice (Huang 1698 and 1766).

Another type is the "compound spadix" (see figures 11) which is a term applied to an individual *Arisaema* plant which bears several scattered small spadices on a large lobed spadix and these little ones are subtended by broad ovate spathes in two series among the female flowers, and it has a large deciduous spathe which covers the "compound spadix." Examples of the "biforked spadix" can usually be found among all the above three species, but the "compound spadix" has only been found on *Arisaema consanguineum* var. *kelung-insularis*.

These abnormal spadices have been proved to be reversible in character. The writer transplanted 30 *Arisaema* corms in the Botanical Garden of National Taiwan University, and found that the "biforked spadix" of female *Arisaema consanguineum* var. *kelung-insularis* (Huang 1766) changed into a simple normal one (Huang 1766a see figure 17). But the "compound spadix" of *Arisaema consanguineum* var. *kelung-insularis* is still in the process of change, and it seems to form the "compound spadix" again on this plant. These 30 corms were collected on Mt. Ali on September 14th to 17th, 1960 and were transplanted on September 19. Some of them began budding in early November, up to-date several female *Arisaema consanguineum* have blossomed, while most of the other *Arisaema* are still in a dormant stage. It is quite interesting to have observed that most female *Arisaema consanguineum* started its flowering and leaf-bearing at the same time.

8. Appendage

This character can be divided into three categories, namely: shape, size and covering of the appendage. The question is, "Is this an important character for distinguishing species?" Dr. Hayata⁽⁴⁾ used the shape and size of the appendage as the basis for distinguishing two species which he described as new. The long-linear form he named as *Arisaema formosana* and the one with a thicker column or clavate form as *Arisaema kelung-insularis* Hay. I have collected both of these kinds of specimens. The external features are so similar that we can not distinguish them without the spadix.

Three types of appendages (see figure 13) are found on *Arisaema taihokensis* Hos-

kawa. One type is broadly conical, another is narrowly conical, and the third is cylindrical. The appendage on female plants is usually larger than on male ones, but there are exceptions. The distinction between this species and *Arisaema arisanensis* has long puzzled the writer. Until now I could not find their real differences. I have made a comparative study of *Arisaema arisanensis*, *Arisaema ringens* and *Arisaema taihokensis* with the help of Dr. Hayata's, Dr. Engler's and Dr. Hosokawa's original descriptions.

(1) Hayata⁽⁵⁾ says: "*Arisaema arisanensis* resembles *Arisaema ringens* (non Thunb., nec Schott) Hay. in having trifoliate leaves and fornicate spathes, and in the spadix: distinguishable from it by having much smaller hairy leaflets with a filiform tip, and in the spadix which is more or less attenuate towards the apex".

(2) Hosokawa⁽⁹⁾ recognized *Arisaema ringens* as a synonym of *Arisaema taihokensis*, but he didn't mention the distinctions between this species and *Arisaema arisanensis*.

(3) *Arisaema ringens* has a cylindrical appendage⁽⁶⁾ which is more or less attenuate at the apex. The appendage of *Arisaema taihokensis* described by Hosokawa's is conical in shape, which is just the same as that of *Arisaema arisanensis*.

(4) The size of leaflets described by Hayata was based on a male plant. They are 12 cm. long by 4 cm. wide. The male plants of *Arisaema taihokensis* have equally small leaflets, and even smaller ones have been collected (Huang 1970, 1989, 1995, 2003, 2013 and 2015). It is difficult to compare the two species because Hayata's new species was based on a single male plant, while Hosokawa's new species was based only on female plants. Female *Arisaema* plants are usually much larger than male ones.

(5) *Arisaema taihokensis* is sparingly hairy (see figure 12D) on the leaflets, their leaves have filiform tips, and most of them have four to five ovules in each ovary, but sometimes they may have two, three or six ovules in an ovary.

(6) Since the small calcium oxalate crystals are abundant all over the dried plants of *Arisaema taihokensis*, they are easily mistaken for the covering hairs unless one examines the specimens carefully.

(7) The tops of ovaries of *Arisaema taihokensis* are acute (see figure 12Ba) which is just the same of Hosokawa's illustration of the true *Arisaema ringens*. But all mature ovaries eventually become flat or rotundate top.

(8) Hosokawa (9) also noted that Taiwan distributed the true species of *Arisaema ringens*. He (9) distinguished his new species from *Arisaema ringens* by the following three characters.

1. The leaflets much narrower and longer.
2. The tops of ovaries flat or rotundate.
3. The ovaries containing always 4 or 5 ovules.

After the carefully examination, I find that the difference is by the shape of leaves

only.

Therefore I believe both *Arisaema taihokensis* and *Arisaema arisanensis* are synonyms of *Arisaema ringens*.

In Hayata's description⁽⁴⁾ *Arisaema kelung-insularis* and *Arisaema consanguineum* both have similar appendages but their leaves are a little different. So I have reviewed the descriptions given by Diels,⁽¹⁾ Engler^(2,3) and Hayata⁽⁴⁾ on *Arisaema consanguineum* (non Hayata) Schott and *Arisaema kelung-insularis*. As a result we find that the pictures and descriptions given by the above three great botanists are the same except the filiform tip of leaflets. In addition, *Arisaema consanguineum* was reported by Engler⁽³⁾ as being from widely distributed areas in temperate and subtropical regions as North-West Himalaya, Yunnan, Szechwan, Shensi, Hupeh, Kansu, Kwangtung, Khasia, Assam, Burma, India and Siam. Therefore I believe *Arisaema kelung-insularis* must be a variety of *Arisaema consanguineum*. Hayata⁽⁴⁾ described *Arisaema consanguineum* with two types of leaflets, that is the linear-lanceolate and obovate-lanceolate and both are 2 cm. wide and 10 cm. long. The latter type is something like Engler's form plant⁽³⁾ although the width is too narrow to agree with it. Engler⁽²⁾ says, "segmentis majoribus, interdum 2 cm. longis, 4-5 cm. latis". I think the former shape is the true *Arisaema consanguineum* and the latter shape may be the *Arisaema consanguineum* forma *latisectum*. The reason I believe that this form plant grows in Taiwan is because it falls in the general geographical range of the species and because of the many specimens have broadly obovate-lanceolate leaves and have clavate or broadly column appendages. The average width of the leaves is 5.43 cm. (see table 1).

Concerning the covering on the appendage, *Arisaema formosana* was described by Hayata⁽⁴⁾ as being either glabrous or having setose hairs. I have also several male *Arisaema consanguineum* forma *latisectum* (Huang 2303-2306 and Shimizu, 1788) with glabrous appendage. For this reason I think *Arisaema biradiatifoliatum* Kitam. is a synonym of *Arisaema consanguineum* forma *kelung-insularis* whose appendage has lost its setose hairs. Although I have had no opportunity to examine *Arisaema biradiatifoliatum* yet, but from the original description we find it has six basic characters:—

1. The leaves are bipalmately compound.
2. The leaflets are linear-lanceolate, 11-19 cm. long by 1-2 cm. wide with attenuate filiform tip.
3. The appendage is clavate in form.
4. Some sterile filiform ovaries are present.
5. The filiform tip of spathe is 4 to 6.5 cm. long.
6. The appendage is glabrous.

Characters 1 to 5 are the same as *Arisaema consanguineum* var. *kelung-insularis* and the last one is considered to be a reversible character. It should be pointed out

that this covering, sometimes, can hardly be observed in dry specimens, especially when hairs are scarce. Likewise, I think *Arisaema oblanceolata* Kitam. is a synonym of *Arisaema formosana* whose leaflets have an abnormal shape. There are also six basic characters recognized:—

1. The leaves are bipalmately compound.
2. The leaflets are oblanceolate, 20 cm. long by 3.5–3.8 cm. wide.
3. The appendage is narrowly linear in form.
4. Some sterile filiform ovaries are present.
5. The appendage is glabrous.
6. The filiform tip of spathe is 12 cm. long.

Characters 1, 3, 4, 5 and 6 are the same as *Arisaema formosana* and the second point has been proved to be variable in the species of *Arisaema formosana*, for Dr. Hayata⁽⁴⁾ says, "The segments of the leaves are very variable in number, shape and size. They vary from 7 to 11, from lanceolate to narrow-linear, from 8 cm. to 25 cm. in length and from 4 mm. to 4 cm. in breadth". I have also collected some female plants of *Arisaema formosana* with oblanceolate leaves.

9. Number of ovules in ovary

This varies on different spadices and in different ovaries on the same spadix. The number of ovules varies from one to eight. But one or two ovules developed into seeds.

10. Spathe

Taiwan *Arisaema* can be divided into two groups based on the shape of spathe. One is saccate and hood-like in form (see figure 12 B, e) the apex of which is modified with large auricles on either side and is never open at the top; the other is without auricles on its sides, is long attenuate, but is usually folded over the spadix and has a very long filiform tip (see figure 1). The former group includes *Arisaema ringens*. The latter group includes *Arisaema consanguineum* var. *kelunginsularis*, *Arisaema consanguineum* forma *latisectum*, *Arisaema formosana*, *Arisaema formosana* form *stenophylla*, *Arisaema grapsospadix* and *Arisaema heterophyllum*.

Table 2. Table showing the relative length of the filiform tip both on the spathe and leaflets.

	length of filiform tip (cm.)	
	spathe	leaflet
<i>A. consanguineum</i> var. <i>kelung-insularis</i>	13*	less than 1
<i>A. consanguineum</i> forma <i>latisectum</i>	20–43	5–12
<i>A. formosana</i>	5–15	less than 1
<i>A. formosana</i> form <i>stenophylla</i>	3–8	less than 1

* Some have the length from 1 to 5 cm. long (Huang 1706a, 1754 1766a, and 1767a).

Key to the species of Taiwan *Arisaema*:

1. Spathe saccate and hood-like, the limb without long filiform tip, and the throat auriculate on both sides *A. ringens*
1. Spathe tubular, the limb usually with a long filiform tip, and the throat without auricles on either side 2
2. Leaves bipinnatifid-pedate..... *A. heterophyllum*
2. Leaves 1-4, not pedate, but with trifoliate leaves or palmately compound..... 3
3. Appendage clavate or thicker column, more than 2 mm. thick at the apex..... 4
3. Appendage linear, less than 1 mm. thick at the apex..... 5
4. Growing plants with the leaves spreading or pointing upward; filiform tip of leaflets less than 2 cm. long; pseudo-stem green or mottled brown.....
..... *A. consanguineum* var. *kelung-insularis*
4. Growing plants with the leaves descending downward like open an umbrella; filiform tip of leaflets more than 3 cm. long; pseudo-stem mottled dark and red or brown
..... *A. consanguineum* forma *latisectum*
5. Appendage penicillate at the apex and glabrous at the base; leaves 1-3, trifoliate or 5-foliate with five or fewer leaflets per leaf on flowering plants.....
..... *A. grapsospadix*
5. Appendage glabrous or only setose at the base; leaves 1-2, palmately compound, with more than six leaflets per leaf on flowering plants..... 6
6. Leaves wider, 3.5-17 cm. long, 0.7-5.5 cm. wide, the leaflets less than ten times as long as wide..... *A. formosana*
6. Leaves narrower, 7-22 cm. long, 0.3-0.6 cm. wide, the leaflets more than ten times as long as wide *A. formosana* form *stenophylla*

11. Conclusion

From the observations mentioned above, four conclusions may be drawn:

(1) Sex determination in *Arisaema* plants are controlled by the age of their corms, so the young plants with small corm and low stem will bear a male spadix, while old plants with a large corm and tall stem will bear a female spadix.

(2) The spadix and number of leaves on old mature female plants are more variable than those of male ones.

(3) The monoecious plant in *Arisaema* is considered to be accidental rather than abnormal.

(4) Some taxa of Taiwan *Arisaema* should be changed as follows:

Arisaema ringens (Thunb.) Schott. Kwa-wi, T, t. 15 (1759)

Hay. Gen. Ind. p. 88.

Matsum. et Hayata Enum. Pl. Formos. p. 457.

Hayata, Icon. Pl. Formos. IX (1920) 147, fig. 54.

Arisaema arisanensis Hay. Icon. Pl. Formos. VI (1916) 100-101.

Arisaema taihokensis Hosokawa, The Journ. of Jap. Bot. XII. 1-2 (1936) 212-215.

These plants are very abundant in Northern Taiwan, they can also be found in the Eastern and Central part of Taiwan from low altitudes up to 2500 m.

Arisaema consanguineum Schott in Bonplandia VII (1859) 27, Prodr. (1860) 52 emend.

Hook. f. Fl. Brit. Ind. VI (1893) 505.

Engler, in Bot. Jahrb. XXXVI. Beiblatt n. 11 (1905) 82.

Engler, Pflanzenreich 73 (1920) 175-176.

Hayata Icon. Pl. Formos. V. (1915) 241-243.

Arisaema erubescens Schott var. *consanguineum* Engl. in DC. Mon. Phan. 11 (1879) 558.

Arisaema Tatarinowii Schott in Bonplandia VII (1859) 27, Prodr. (1860) 53.

Engler, in DC. Mon. Phan. 11. (1879) 559.

Engler, in Bot. Jahrb. XXIX. (1901) 236.

Arisaema vituperatum Schott in Bonplandia 11. (1859) 28, Prodr. (1860) Pr. p.

Arisaema filamentosum Wall. Cat. 1155.

Arisaema consanguineum Schott forma *latisectum* (Engl.) Engl. in Engler

Pflanzenreich 73 (1920) 176-177.

Arisaema Tatarinowii Schott forma *latisecta* Engl. in Engler's Bot. Jahrb. XXIX (1901) 236.

Diels Fl. von Central-China (1901) 236.

I think it is better not to apply the form name of *Arisaema consanguineum* forma *latisectum* for this species, since the size of leaflets are much variable by their different age of plants and various ecological factors. This species is found from medium altitudes up to 2300 m. It has a wide range of distribution being also found on the mainland of China, Himalaya, Khasia, Assam, Burma, Siam and India.

Arisaema consanguineum Schott var. *kelung-insularis* (Hay.) Huang comb. nov.—

Arisaema kelung-insularis Hay. Icon. Pl. Formos. V. (1915) 246.

Arisaema biradiatifoliatum Kitam. Acta Phytot. Geob. V. 3 (1941) 187-188.

This variety has been thought to be distinct from *Arisaema consanguineum* for a long time, now it is evident that its difference is in the filiform tip of leaflets only. Thus, the writer intends to propose the variety name for this plant. Some specimens collected on Mt. Ali (Huang 1706a, 1754 and 1766a) have the shorter filiform tip of leaflets as well as their shorter spathe-tip (less than 5 cm. long), these are not the same as the dimensions given for *Arisaema kelung-insularis*. but it seems best to consider these plants as a variety until further study.

Arisaema formosana Hay., Icon. Pl. Formos. V. (1915) 243-245.

Arisaema oblanceolata Kitam. Acta. Phytot. Geob. V. 3 (1941) 188-189.

Arisaema adienatum Schott var. *formosana* Hayata Mater. Fl. Formos. p. 371.

These plants grow luxuriously from low altitudes to high altitudes throughout

Taiwan. It is very near to *Arisaema concinnum* Schott but differs from it by its more slender appendage.

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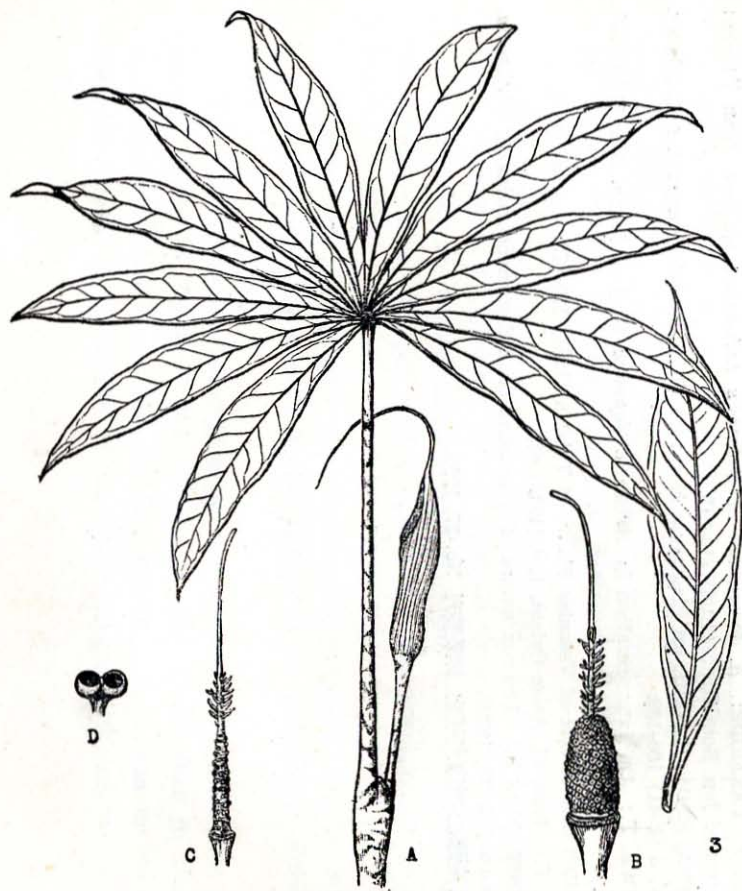


Fig. 3. Dioecious *Arisaema formosana* Hay. collected at Chi-Tou Tract, Experiment Forest of National Taiwan University, Nantou Co., (Huang 1401', Drawn by C. C. Kuo).

- A. Whole plant 1/3
 B. Female spadix.
 C. Male spadix x2
 D. Stamen

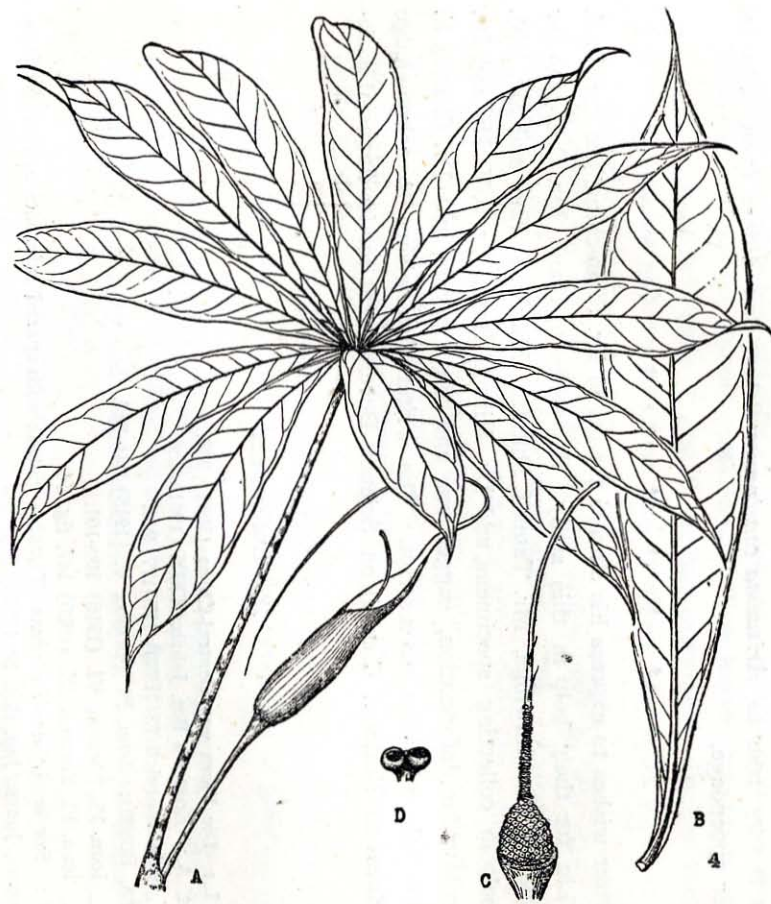


Fig. 4. Monoecious *Arisaema formosana* Hay. collected at Chi-Tou Tract, Experiment Forest of National Taiwan University, Nantou Co., (Huang 1401, Drawn by C. C. Kuo).

- A. Whole plant 1/2
 B. A leaflet
 C. Monoecious spadix with male flowers on the upper part and female flowers on the lower part.
 D. Stamen.

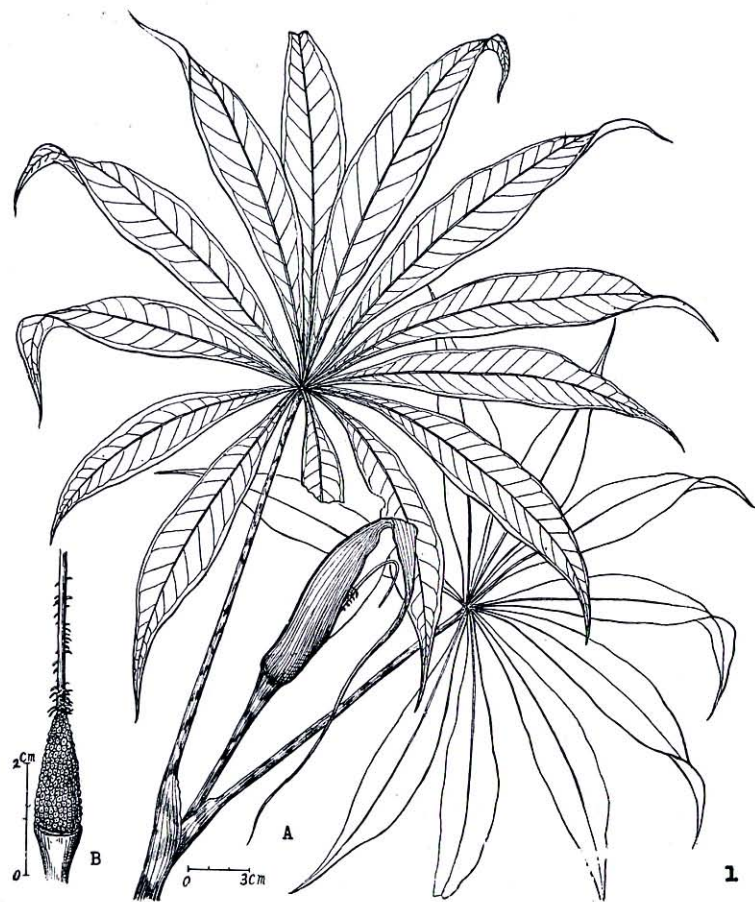


Fig. 1. A female plant of *Arisaema formosana* Hay. (Huang 1440) with bipalmate compound leaves which was collected on Chi-Tou Tract (Drawn by C. C. Kuo).

A. Whole plant. This has an open tubular spathe with a long filiform tip.

B. Female spadix without spathe.

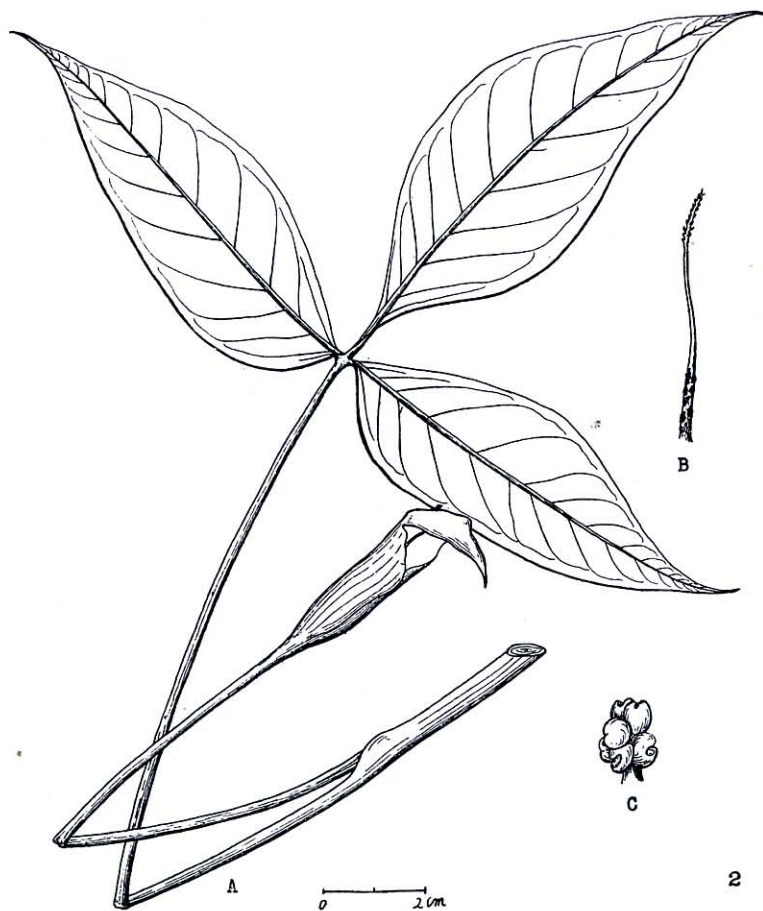


Fig. 2. A male *Arisaema grasospadix* Hay. with a simple trifoliate compound leaf (Matsudai, E. 447, NTU).

Arisaema Matsudai Hay. is a synonym. (Drawn by C. C. Kuo).

A. Whole plant.

B. Male spadix with penicillate appendage at the apex.

C. Stamen $\times 30$



Fig. 5. A well-grown female plant of *Arisaema consanguineum* forma *latisectum* (Engl.) Engl. with more than 10-leaflets per leaf growing under *Chan. aecyparis obtusa* var. *formosana*. (Hay.) Rehd.

Fig. 6. Quadri-palmate compound leaves of female plant of *Arisaema consanguineum* forma *latisectum*. (Engl.) Engl. I collected this on Mt. Ali (Huang 1659). Each leaf has 7, 8, 10 or 11 leaflets.

Fig. 7. A picture of *Arisaema consanguineum* Schott var. *kelung-insularis* (Hay.) Huang with simple normal spadix was transplanted on September 19, 1960. It had abnormal biforked spadix (Huang 1766) at the top formerly. Above, whole plant body; Below, A spadix.

Fig. 8. *Arisaema grapsospadix* Hay. with bi-palmate compound leaves and their leaves bearing 3-, 4- and 5-leaflets (Matsudai, E. 5446, TFRI). *Arisaema quinquefolia* Hay. is a synonym.

Fig. 9. A male plant of *Arisaema grapsospadix* Hay. with tri-trifoliate compound leaves (Suematsu, N., 5417, TFRI).

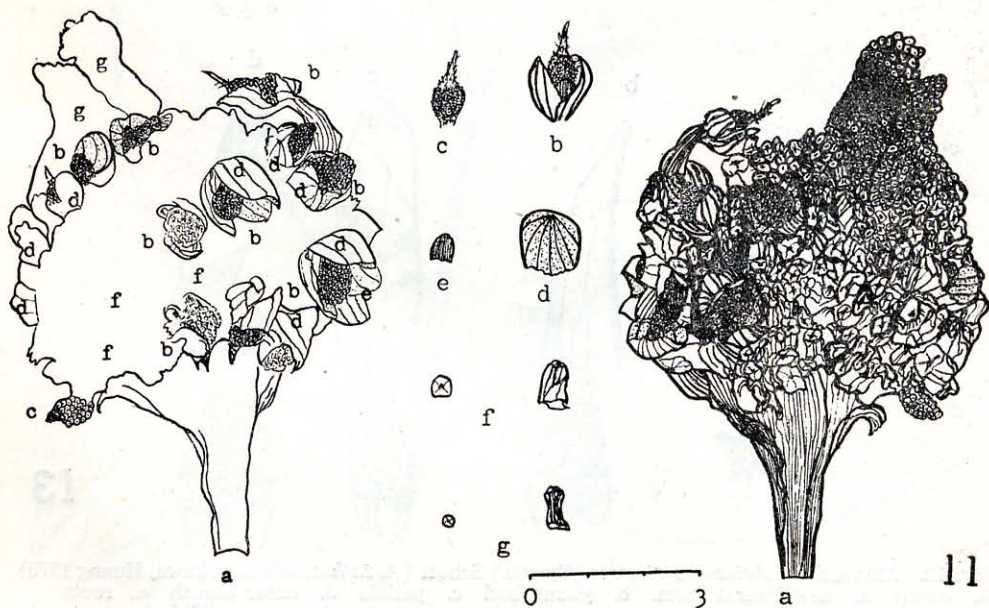
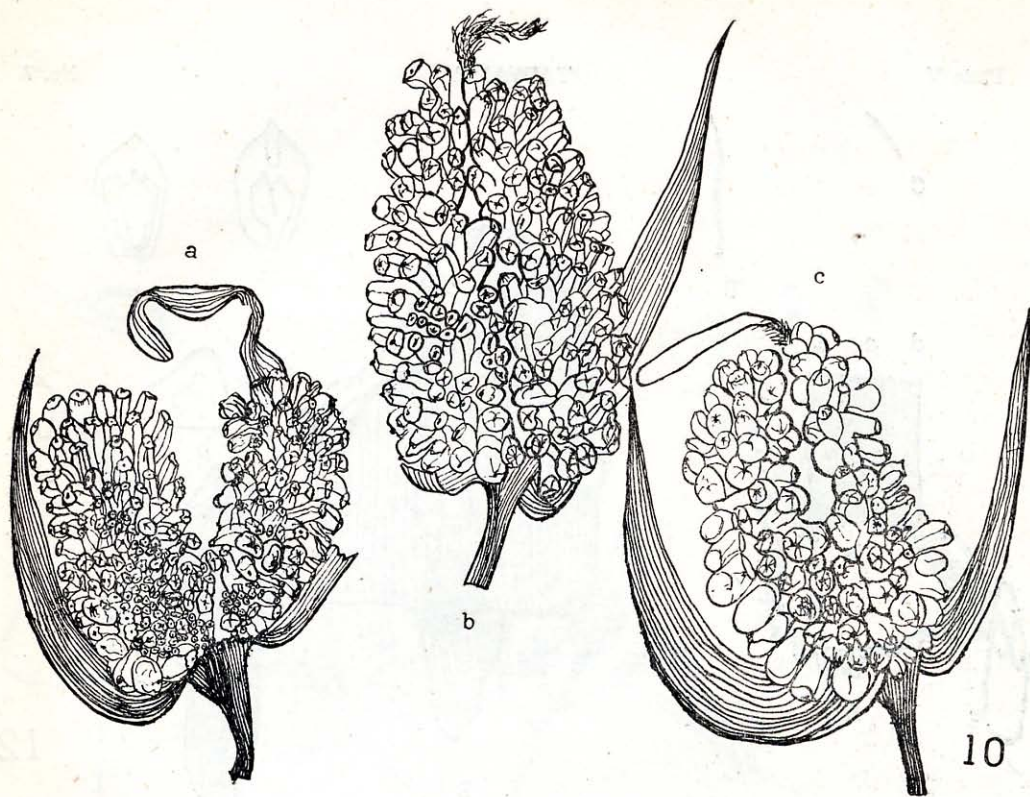


Fig. 10. Abnormal biforked spadix with one appendage
 a. *Arisaema consanguineum* forma *latisectum* (Engl.) Engl. (Huang 1711)

b. *Arisema formosana* Hay. (Huang 1667)

c. *Arisaema-consanguineum* Schott var. *kelung-insularies* (Hay.) Huang (Huang 1682)

Fig. 11. Abnormal spadix of *Arisaema* forma *kelung-insularies* (Hay.) Huang (Huang 1706) showing;

a. Compound spadix with a large deciduous spathe.

b. Small spadix subtended by small broad ovate spathes, and it has shorter appendage than normal ones.

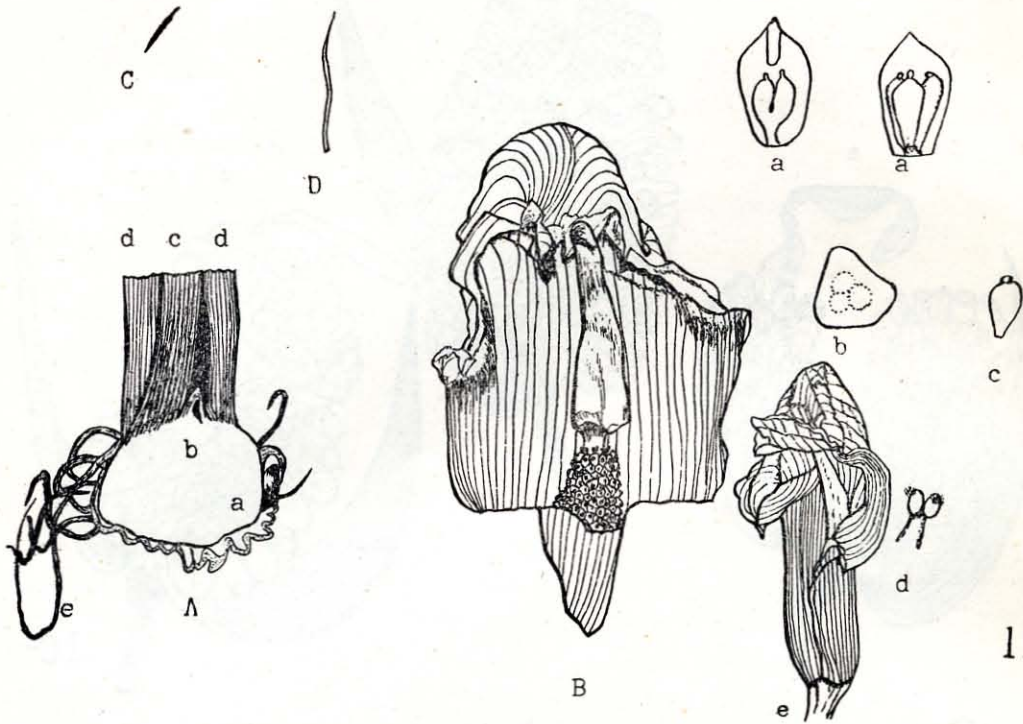
c. Small spadix without small spathe.

d. Large outer spathe of a small spadix.

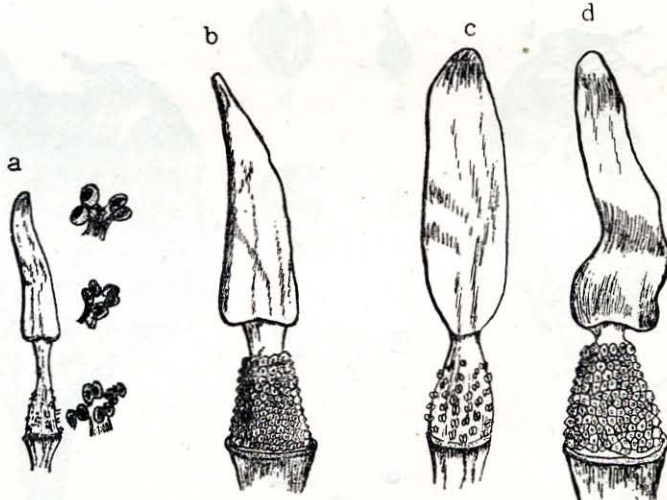
e. Small inner spathe of a small spadix.

f. Lower large female flowers, side and top view.

g. Upper small sterile female flowers, side and top view.



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Fig. 12. Monoecious *Arisaema ringens* (Thunb.) Schott (*A. taihokensis* Hosokawa, Huang 1975)

A. corm; a. new lateral corm. b. young bud c. petiole d. outer sheath e. roots

B. Spadix; male flowers on most upper parts, the rest are female flowers. This has a saccate hooded spathe with auricles and a conical appendage

a. ovary, with 2-6 ovules, $\times 40$

b. cross section ovary with three ovules $\times 40$

c. ovule $\times 50$

d. stamen with two anthers $\times 30$

e. saccate hooded spathe with auricles

C. Need-like crystals of calcium oxalate found abundantly on whole plant, 3.6-6 μ . long.

D. Marginal hair on leaflets 66 μ . long, 1.2 μ . wide.

Fig. 13. Several types of appendages on *Arisaema ringens* (Thunb.) Schott. (*Arisaema taihokensis* Hosokawa is a synonym).

a. Narrowly conical shape (Chao J.M. 552) from a fresh specimen

b. Broadly conical shape (Chao J.M. 548) from a fresh specimen

c. Cylindrical shape (Kawakami, T. 4347, TFRI) from a dried specimen

d. Cylindrical shape (Mori, U. 5440, TRRI) from a dried specimen