Reproduction strategy of *Trias verrucosa* (Orchidaceae) from China

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Abstract: *Trias*, an orchid genus, was reported in this paper from China as a newly recorded genus for the first time. The genus and its new species, *T. verrucosa* Z. J. Liu, L. J. Chen et S. P. Lei, were described and discussed. *Trias* consists of 19 species ranging from Assam of India to Indonesia and Australia in the southeast via Myanmar to Deccan of India in the southwest. Its occurrence in West Yunnan of China is a further indication of phytogeographical relations between this region and the tropical Asia. This new species grows on shady rocks in forests. By observing of its biological characteristics such as phenology and blooming biology, lots of cloned ramets of generation overlap were found, but there were no fruited plants, and that clonal reproduction could repeat had nothing to do with whether the ramet bloomed or not. The flowering season of this species is from early April to early May. The opening of flowers on plants or inflorescence was irregular and the florescence of single flowers was rather short, only lasting 4–5 d, and no fruited flowers were found. Based on the detection of mating systems, no flowers of artificial self-pollination and artificial cross-pollination have fruited. Since the flowering period is just before the rainy season in this region, the ecological conditions of dryness, strong wind, low temperature and weak light during that period of time are evidently unfavorable to plant blooming, pollinating and fruiting. Apparently, the short duration and sterility of each flower would avoid the invalid energy waste in unfavorable circumstances and save the limited energy for more valid asexual reproduction so that the opportunity of multiplication in an uncertain environment would be increased to ensure the progenitive success. The P/O value of *T. verrucosa* is 187.4 ± 22.4, which is obviously related with the highly valid usage of its conglutinated and hard tuberous pollinarium during pollination, indicating that this species could hold the characteristic of sexual reproduction. This is an adaptation of this type of plants to the rather atrocious ecological circumstance there by its reproduction strategy of strengthening asexual reproduction and weakening sexual reproduction, and so it enables the plants to survive in this region, long-distanced from the places where its relatives dwell.

Key words: *Trias*, *Trias verrucosa*; new recorded genus; new species; phenology; blooming biology; reproduction strategy

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China has about 1300 species of orchid, in 177 genera, of which Subtribe Bulbophyllinae Schltr. has about 108 species in 3 genera[1]. Plants of this Subtribe are epiphytic herbage with creeping rhizome and pseudobulb. Each pseudobulb has one fleshy leaf on the top; the labellum is on the end of the column-foot, which is referred to as “see-saw lip”. Most species of Subtribe Bulbophyllinae are small and they grow on a tree trunks or cliff stones, which cause a lot of inconvenience to the discovery of new-species and the biological observation of this Subtribe. At present, there are several reports on the pollination biology of genera *Bulbophyllum* in the world[23], and yet there is no report on the progenitive biological studies of genera *Trias* such as flowering phenology, mating system, pollination biology, progenitive mode and their relationships, especially on progenitive biology in a heterogeneous condition[14]. Therefore, in combination with research on *Trias* of Subtribe Bulbophyllinae, a newly recorded genus in China, we try to study the progenitive system of the new species *Trias verrucosa* which survives in areas far away from its relative of the same genus, to discuss the phenological characters, floral configuration and flowering mode of this type of plants, and probe the adaptive countermeasure of progenitive characters which relate to sexual expression to the environment.
1 A newly recorded genera *Trias* in China

In April of 2006, during the observation of orchid resource in Gaoligong Mountain of Lushui Country, Yunnan Province, China, many communities of orchid similar to *Bulbophyllum* grew on shady stones under the forest, which had lots of cloned offshoots but no fruited genets or fruited survivors in former years. Its pseudobulb has one leaf or fallen leaves, and abuts on each other that forms a catenulate shape. Fleshy flower generates from the pseudobulb base with or without leaves. The outer surface of perianth is marked with purplish red speckles and the inter surface is densely covered by purplish red spots and mastoid warts. The sepals are similar and outspread triangularly. Petals are thick and short. The cap of anther extends forwards to be horny. Apparently, these characters are different from those of *Bulbophyllum*, but similar with those of *Trias* Lindl.

*Trias* is a name established by J. Lindley in 1830. It is very closely related to *Bulbophyllum* and treated by many botanists as a section of *Bulbophyllum*. In 1976\(^2\), 1986\(^6\) and 1992\(^7\), however, G. Seidenfaden reconsidered it to be a separate genus and listed 10 species under it. He described this genus as one with a horn-like or Y-shaped prolongation at the anther apex and three sepals similar in size and shape. Up to now altogether 19 species are known, but none of them is from China\(^1\)\(^,\)\(^6\),\(^7\).

This genus is distributed in tropical area, ranging mainly from Assam in India to Indonesia and Australia in the southeast via Myanmar to Deccan in India in the southwest\(^5\),\(^7\). The live specimen we found came from the mid-part of the Gaoligong Mountains in western Yunnan. It not only has geographic separation with its relative, but also has visible difference in floral characters with all known species in this genus. It should be a new taxonomic group\(^8\). Though the new species grows in areas far away from its relative, this area also has many other epiphytic orchids in southeast Asia such as *ChrysoGLOSSUM ORNATUM* Bl., *Coelogyne Viscosa* Rehb. f., *DendroBium Heterocarpum* Lindl. and *D. Aphyllum* (Roxb.) C. E. Fischer\(^1\),\(^3\). This indicates that the mid-part and its southward of Gaoligong Mountains are the home to many tropical epiphytic orchids. The occurrence of *Trias* in this region is an addition to this pattern of distribution at the generic level.

*Trias* Lindl.


Epiphytes; rhizome creeping; pseudobulb close or distinct; 1 acrogenous leaf, elliptic; scape arising at the base of the pseudobulb and base with sheath and with 1–3 flowers, thickness; sepal extending triangularly; dorsal sepal broad-ovate elliptic or suborbicular or elongated isosceles-triangle; lateral sepal similar to dorsal sepal and base adnate to the end of column-foot, forming a mentum; petals linear or elliptic and smaller than sepal; labellum fleshy, the upper part retrorse and the base linked with the end of column-foot, forming active joint; lip disk with wart tubercle or not, or with groove and pleat sometime; column short with wing and base extending to be foot; anther 2 cells, pollinia 4, 2 pairs; the forepart of another cap elongated to be comet of broad-linear and the apex obtuse or furcated.

**TYPUS GENERIC: Trias ablonga** Lindl.

Approximately 20 species, distributed in Myanmar, India, China, Laos, Vietnam, Indonesia and Australia.

Newly recorded in China, only represented by one species.

*Trias verrucosa* Z. J. Liu, L. J. Chen et S. P. Lei, sp. nov.

Fig. 1

**Type**: Lushui Country, Yunnan, China, on rocks in broad-leaved forest, alt.1900 m, 12 April 2007, Z. J. Liu3408 (holotype, NOCC).

Species nova *Trias disciflorae* (Rolfe) similes, a qua bene differt corolla intra densus verruca; petalis ellipticus, multo majoribus 1.2–1.4 cm longis 0.9–1.1 cm latis.

Lithophytes; rhizome creeping; 2–3 mm thick and densely rooting; pseudobulbs close, ovoid, 2.5–5 cm long, 1.8–2.5 cm thick, with a single leaf apically; leaf elliptic or narrowly elliptic, coriaceous, 15–19 cm long, 2.8–6 cm wide, apex obtuse; petiole 3–8 cm long; scape, 1–2 cm, arising at the base of the pseudobulb, 3–4 cm long, and base with a broad-ovate sheath; inflorescence with 1–3 flowers; floral bracts 6–8 mm long and basal half cup-shaped; pedicel and ovary 3–3.5 cm long; pale green-yellow spotted with purple-red; flowers 3–3.3 cm across, fully opening, more or less with putrid smell of rotting fruit, pale green-yellow spotted with purple-red; adaxially with dark purple-red spots and densely verrucose-warts; sepals elliptic-ovate, 2–2.3 cm long, 1.1–1.3 cm wide, apex acute; lateral sepals adnate to the column-foot, forming a conspicuous mentum; petals subelliptic, 1.2–1.4 cm long, 0.9–1.1 cm wide, apex acute; lip fleshy, ovate, 1.1–1.2 cm long, 0.6–0.7 cm wide, recurved, apex obtuse, unlobed, channeled basally, with 2 longitudinal ridges beside the channel; lip disk with wart tubercle or not, or with groove and pleat sometime; column-foot, forming a mentum; petals linear or elliptic and smaller than sepal; labellum fleshy, the upper part retrorse and the base linked with the end of column-foot, forming active joint; lip disk with wart tubercle or not, or with groove and pleat sometime; column short with wing and base extending to be foot; anther 2 cells, pollinia 4, 2 pairs; the forepart of another cap elongated to be comet or broad-linear and the apex obtuse or furcated.

**Taxonomic notes**: This new species is akin to *Trias disciflora* (Rolfe) Rolfe, from which it differs with much larger petals ca. 1.7 cm long and 1.2 cm wide.

**Habitat**: On rocks in evergreen broad-leaved forests at an elevation of 1900 m.

**Distribution**: In Southwest Yunnan, found only in type locality (Lushui country).
2 Location and climate of the observation site

The observation was carried out in the location of type specimen. The type of climate is subtropical mountainous monsoon climate. The average annual temperature is 15.1°C, average temperature is 9.1°C in the coldest month and 19.6°C in the hottest month, extreme high temperature is 31.8°C and extreme low temperature is 0.6°C; the frostless period is 282 days per year and the annual rainfall is 1213 mm. Dry season is from November to May and rainy season is from June to October. The time of yearly sunlight is 2045 hours, high-temperature season is July and August and low temperature season is from December to February. The main weather disasters are drought, continuous overcast and rain, low tem-

Fig. 1 Trias verrucosa Z. J. Liu, L. J. Chen et S. P. Lei
perature and strong wind, and so on\[^{[9,10]}\].

3 Method

3.1 Observation on phenology characters

Referring to the investigation methods on the growth status and asexual progenitive characters of P. armeniacum by Liu\[^{[11]}\], detailed observation records of plant growth in the community were made during different periods from April of 2006 to May of 2007.

3.2 Observation on characters of flowering phenology

3.2.1 Observation on characters of floral configuration: 10 opening flowers were randomly picked up during the full-blown period and the floral configuration characters were observed under an anatomic microscope. The sizes of calyx, petals, labellum, pistil and stamen, etc. were indirectly measured.

3.2.2 Observation on flowering pattern: before opening, 10 genets with similar size and in similar growing way were chosen and the inflorescences of similar size were marked. The following items were observed continuously and made record: the opening sequence and blooming duration of each inflorescence, the opening sequence of flowers on each inflorescence, the opening time and duration of a single flower, and the changing time of the anther (stamen) and the stigma (pistil).

3.2.3 Test of pollen/ovule value: pollinia of 10 blown flowers were randomly picked up from different genets in anthesis and their volumes were measured under the anatomic microscope, and then pressed on disc under an optical microscope to count the volume of each pollen grain after being photographed via a digital camera and a computer microscope. The volume of pollinium divided by the volume of pollen grain is the number of pollen in each anther, and the number of ovule in each ovary can be obtained in the same way and then the value of pollen/ovule of a single flower can be calculated. The pollen/ovule value equals to the pollen number of a single flower divided by the ovule number of a single flower.

3.3 Detection of mating modes

3.3.1 Tests of artificial self-pollination and artificial cross-pollination

During each anthesis in 2006 and 2007, 60 flowers of 6 communities were marked to carry out the experiments of artificial self-pollination (30 flowers) and artificial cross-pollination (30 flowers). The blooming time of each flower was recorded when the flower just blossomed and then at every 24-hours, one treatment was carried out with 5 flowers as one group.

3.3.1.1 Artificial self-pollination: flowers were bagged before blossoming; after blossoming, the rostellum was staved by a pencil point and the pollinium was taken away from the anther cap and put into the stigma cavity of the same flower. Then flowers were bagged again. The changing status and fruiting status of each flower were recorded.

3.3.1.2 Artificial cross-pollination: flowers were bagged before blossoming; after blossoming, the rostellum was staved by a pencil point and the pollinium was taken away from the anther cap and put into the stigma cavity of a flower in another community. Then flowers were bagged again. The changing status and fruiting status of each flower were recorded.

3.3.2 Tests of natural pollination, bagged pollination and removed stamen

Treatments of natural pollination, bagged pollination and removed stamen were set for comparison, there were 6 samples for each treatment and 5 flowers for each sample.

Natural pollination: without any treatment, observe and record the status of pollination and fruiting status of each flower in natural condition.

Bagged pollination: put the soon blossoming flowers in a transparent bag to avoid insect contact, observe and record the status of pollination and the fruiting status of each flower.

Bagged removed stamen: put the soon blossoming flowers in a transparent bag, remove the pollinium after opening, bag them again, and then observe and record the fruiting status.

3.4 Observation on pollinating agent

10 flowers were randomly marked in full-blown anthesis, and the pollinating agent of each flower was continuously observed from opening to fading. The behavior of each pollinating agent was photographed and videoed.

3.5 Data analysis

The above data were analyzed via SPSS11.5 software.

4 Result and analysis

4.1 Observation on phenology

The result of phenology observation is shown in Table 1. Based on the detailed observation of T. verrucosa in different periods of growth, the phenology characters of T. verrucosa are shown as follows: (1) Asexual period: the plant has strong ability to bourgeon asexual plumule, and the asexual plumule would start to germinate synchronously from the base of pseudobulb growing in the same year or in next year or from the base of some perennial ones in the last ten days of

<table>
<thead>
<tr>
<th>Clone rameting</th>
<th>Leafing</th>
<th>Flower bud appearing</th>
<th>First flower appearing</th>
<th>Full blooming</th>
<th>Flowering termination</th>
<th>Fruit appearing</th>
<th>Fallen leaf</th>
<th>Life cycle (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 Feb.</td>
<td>5 Mar.</td>
<td>26 Mar.</td>
<td>2 Apr.</td>
<td>28 Apr.</td>
<td>10 May</td>
<td>Not found</td>
<td>Nov.–May</td>
<td>7</td>
</tr>
</tbody>
</table>
February. It takes 7 years or more than 7 years for a pseudobulb to grow from sprouting to fading, and during that time it could germinate asexual plumule, and the asexual plumule could germinate a new one after the vegetative growth period which makes the plant grow catenulately. (2) Complete vegetative growth period: the phase from plumule germination to bud emergence or to pseudobulb mature growing plumule lasts one year; usually, new grown leaves would fall off in the dry season of the same year or next year. (3) Period of vegetative growth coexisting with sexual procreation: the period from bud emergence to full-blown anthesis lasts shortly, only about one month. After anthesis, no fruited plant by insemination was found, neither were seedlings or fruit leftover from former years in communities. It could be summed up from these 3 phrases that during the whole life cycle of T. verrucosa, the complete vegetative growth period was much longer, occupying 11/12 of the whole life period. In this period T. verrucosa could rapidly achieve the transition from asexual reproduction to vegetative growth and then to asexual reproduction or sexual reproduction, and finally it could enter the period of vegetative growth coexisting with sexual procreation. Therefore, in terms of phenology characters, the progenitive growth of flowering T. verrucosa plants occupies 1/12 of its life cycle. During the anthesis of old pseudobulb, the asexual gemmules of genets were on the vegetative growth period. In communities, buds came out in the last ten days of March, began to bloom in the early April, and its full-blown period appeared in the middle ten days of April, and anthesis was finished in the early May. Every flowering pseudobulb could shoot out 1–2 scapes. Based on the speed of bud germination and the kraurosis status of pseudobulb, calculating time from space showed that the pseudobulb could still survive for about 6 years after vegetative growth stops and some pseudobulbs never flower through its whole life. Genets could fissiparously produce individual ramets separated from their mother genets as old pseudobulbs dry rot.

4.2 Phenology characters of opening flowers

4.2.1 Observation on floral configuration character

The floral configuration of T. verrucosa can be seen in the description of this new species, and the quantity characters are shown in Table 2.

Based on Table 2, the stigma cavity of T. verrucosa is larger than pollinium with notable differences in their length and width ($t=9.297$, $df=18$, $p=2.7E–0.8$; $t=37.425$, $df=18$, $p=1.6 \times 10^{-18}$), indicating that the stigma cavity has enough space to receive 4 pollinia (the whole pollinium) at one time. Moreover, the 4 pollinia of T. verrucosa are conglutinated in pairs and the pollinia have no viscid disc, so generally it is much more possible that only one pair of pollinia fall into the stigma cavity if there is pollination by insects.

4.2.2 Observation on flowering pattern

The flowering patterns of T. verrucosa present as follows: (1) there was no opening sequence on inflorescence, and during the whole anthesis the inflorescence axis did not elongate; (2) one flower opened each day on the multi-flower inflorescence, but there was no opening sequence; (3) it took $(6.5 \pm 0.5)$ h ($n=10$) for a flower to outspread its perianth to full-blown. The full blossom lasted for 3 days and then the flower began to close till dry rot. This process took about 1.5 d. Anthesis of a single flower averages $(4.5\pm0.5)$ d ($n=10$) (Fig. 2). The perianth would close 12 h later if the flower was pollinated.

4.2.3 Calculation on P/O value

The observation result of P/O value of T. verrucosa is shown in Table 3.

4.3 Detection of mating modes

4.3.1 The test results of artificial self-pollination and artificial cross-pollination are shown in Table 4.

In different times and different pollinating modes, the tooth of rostellum on both sides of the stigma, and the ovary in pollinated flowers started swelling in 6 h, but after 3 d, all the

![](image1.png)

**Fig. 2** Flowering dynamics of 3-flower inflorescence in Trias verrucosa

<table>
<thead>
<tr>
<th>Item</th>
<th>Sepal</th>
<th>Petal</th>
<th>Lip</th>
<th>Pollinarium</th>
<th>Ovary</th>
<th>Stigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>21.5±1.5</td>
<td>12.9±1.0</td>
<td>1.1±1.0</td>
<td>1.54±0.14</td>
<td>4.3±0.3</td>
<td>2.03±0.07</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>11.8±0.9</td>
<td>10±1.0</td>
<td>7.1±0.6</td>
<td>0.91±0.05</td>
<td>2.7±0.1</td>
<td>1.95±0.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of pollen/flower</th>
<th>Number of ovule/ovary</th>
<th>P/O value</th>
</tr>
</thead>
<tbody>
<tr>
<td>938179±210908</td>
<td>5006±1126</td>
<td>187.4±22.4</td>
</tr>
</tbody>
</table>

| Table 3 Pollen-ovule ratios in Trias verrucosa |
pollinated flowers stopped growing and then became seared. There was no fruit in artificial self-pollination nor in artificial cross-pollination. After pollinated, stigma and ovary swelled quickly, indicating that the insemination was under way, which proved the vigor of both pollen and stigma and excluded the possibility of dichogamy in *T. verrucosa*. The flower dried during insemination, reflecting that there was obstacle in insemination of this species.

4.3.2 The fruiting rates of natural pollination, bagged pollination and removed stamen are shown in Table 5.

The naturally fruiting rate of *T. verrucosa* is 0; the fruiting rates of bagged flowers with or without stamen are both 0, indicating that *T. verrucosa* could neither have automatic self-pollination nor produce asexual seeds.

In Orchidaceae, the fruited inflorescence axis and capsule shell could stay on the plant for at least 3 years (Liu, unpublished). Therefore, the result of mating mode detection is accordant with that no leftover from fruiting at the same year or in former years was found during phenology observation (could check each live pseudobulb), which further proved the invalidation in sexual reproduction of this species.

4.4 Observation of pollinating agent

The position of pollinia in the anther of the observed flowers did not change, and no insect was found to touch the stigma or anther. All marked flowers for observation dried rot, indicating that flowers of this species might lack or have no function to attract the pollinating agent and the environment might also lack of pollinating agent.

5 Discussion

The above results show that *T. verrucosa* has invalid sexual reproduction but has highly effective asexual reproduction. It has no sexual reproductive limitation in floral structure. The pollinium matches the stigma vigor. The probably existent insemination obstacle brings about the unfruition to its self-pollination and cross-pollination. This species cannot produce asexual seeds, but it introduces the progenitive strategy of abandoning sexual reproduction and reinforcing asexual reproduction to ensure its survival and multiplication with its adaptation to the heterogeneous habitat and the balance of resource use. It invests the resource in the single asexual reproduction instead of in both sexual reproduction and asexual reproduction to avoid frustrating effect which could result in species extinction[12]. It may be an evolitional strategy of this species in the environment of dryness, cold, strong wind, low sunlight and lack of pollinating insects[13]. To adapt to the rhythm of climate change, *T. verrucosa* develops a relevant plant growing rhythm which is an adaptation to the utilization of the surrounding environmental resource in terms of physiology and configuration shown by its phenology. As a perennial plant, the beginning of its growth and procreation and their duration all relate to the local climate condition. Its seasonal defoliation and larger leaves acclimatize itself to the ecological conditions of seasonal drought and low sunlight. Its rhizome is so short that its pseudobulbs grow glomerately which could enhance its adaptive ability to the dry, cold and barren habitat. On the other hand, it is also reflected that this

<table>
<thead>
<tr>
<th>Flowering date</th>
<th>Manual self-pollination</th>
<th>Manual cross-pollination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of flowers</td>
<td>Number of fruits</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
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</tr>
<tr>
<td>3</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>0</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Natural</th>
<th>Bagged</th>
<th>Removed anther</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of flowers</td>
<td>Number of fruits</td>
<td>Rate of fruit set (%)</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
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<td>0</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
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</table>
species has a mass of cloned ramets, but its capacity to find new habitat or avoid unfavorable habitat is rather weak\[11\]. However, *T. verrucosa* grows well in the mid-part of Gaoligong Mountain in Yunnan and adapts very well to local climatic condition. The occurrence of this species is not only an addition to the orchid flora in west Yunnan, but also provides a new evidence for the close relation between this region and the tropical Southeast Asia in terms of geobotany\[12\].

The flower of *T. verrucosa* is hermaphroditic. In terms of floral characters, there is no obstacle in sexual reproduction but the difference between the size of pollinia and the stigma cavity is obvious; the latter one is larger than the former one, which provides an advantage for pollinia to enter into the acceptant surface of the stigma. In terms of flowering patterns, the opening of flowers in this species, no matter on the same inflorescence or on a different one, has no notable law. But the opening patterns of the single flower are similar and the blooming duration is rather short. All these characters are seasonized with the special environmental conditions in the original habitat. In its distributing areas the anthesis of this species is from the early April to the early May, that is to say, its florescence and fruition could finish before the coming of rainy seasons. At that time, the ecological conditions of dryness, strong wind, low temperature and weak light are evidently unfavorable to plant blooming, pollinating and fruiting. Therefore, the short duration of single flowers, the irregular opening of this species on flowering biology, and even some pseudobulbs never flowering, all are to avoid the disadvantageous conditions and to turn away or end the fruitless resource waste as soon as possible\[11,12\].

Mating system is the pattern an organism used to pass their germ plasm from generation to generation via sexual reproduction, including all attributes of controlling gametal combination to form a zygotes \[14\]. In a hermaphroditic plants, the P/O value could reflect the mating pattern\[15\]. The mating modes of orchids include selfing, crossing and one with selfing and crossing\[2\]. These mating modes are controlled by genetic substance, and they also have close relation with the environmental conditions. For instance, *Holcoglossum amesianum* is a plant that keeps the floral structure for cross-pollination and still has self-pollination and self-fertilization at the same time, which could automatically carry out self-pollination in conditions of drought and lacking pollinating insects\[11\]. The observation on pollinating agency and the detection of mating systems show that, in nature, *T. verrucosa* cannot produce sexual or asexual seeds although the asexual individual of genet grows densely which could become independent individuals by fissiparism, and its community has the advantage of cross-pollination on the same plant and cross pollination. Based on the P/O value and the hard agglomerate pollen, if only one pollinia enters the stigma cavity, the need for all ovule to be fertilized is met\[16\], indicating that *T. verrucosa* has had a safe, economic and effective breeding system. No mating modes\[15\] or fruited plants have been found because under uncertain environmental conditions, the flowering and pollinating processes have to face bad climate. In order to avoid the risk of breeding failure caused by conditions in habitat, this species evolves another mechanism to safeguard multiplication via its asexual reproduction, in which the pseudobulb could produce gemmules to enlarge the colony quantity\[17\] and ensure its continuing life for successful reproduction no matter whether it flowers during its long evolutionary process. So *T. verrucosa* could survive in areas far away from its relative. Therefore, survival guarantee is considered to be the motivation during the evolution of asexual reproduction in plants. The survival way of *T. verrucosa* is an example.

No organism could make everything function well at one time. Each year, *T. verrucosa* still has some pseudobulbs flowering and does not completely abandon sexual reproduction, but the use of energy in sexual reproduction is costly and has no good effect, so it will certainly affect the survival rate in its late lifecycle\[17\]. The energy *T. verrucosa* used for growth, and maintaining development and propagation is limited, so it must look for a best solution to effectively distribute this limited resource among these conflicting needs, that is, to strengthen asexual reproduction and weaken or even abandon sexual reproduction. The reproductive strategy of *T. verrucosa* may show that ecological genes may be the factor that influences the sexual reproduction variation, accelerates this plant which grows in heterogeneous conditions to transform its reproductive way from sexual reproduction to asexual one, which could result in ecological infertility under conditions of weak light\[18\], low temperature and seasonal dryness\[19\], and even lays a foundation for the evolution of genetic infertility\[20\]. If these ecological factors are removed, whether *T. verrucosa* could reuse sexual reproduction or use another reproductive strategy is an issue which needs further study.

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