筑波実験植物園研報　16：69–74, 1997.
Ann. Tsukuba Bot. Gard.

A Note on the Pollination of *Oreorchis patens* (Orchidaceae)

by

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杉浦直人*・岡島安宏*・前田泰生*: コケイランの受粉に関する知見

Among ca. 10 species of the Asian genus *Oreorchis* Lindley, only one species, *O. patens* (Lindley), Lindley is distributed in Japan (Maekawa 1971, Satomi 1982). No information is hitherto available on the pollination of most species of Japanese orchids including *Oreorchis* and its allied genus *Kitigorchis* (i.e., *K. itoana*; Maekawa 1971). As for another allied genus *Corallorhiza*, however, the flowers of some species are reported to be regularly autogamous, though the pollination by insects is found incidentally (Catling 1983, Cingel 1995). We report here preliminarily some aspects of the pollination of *O. patens*.

Materials and Methods

A survey was carried out at a deciduous forest (alt. ca. 500 m) in Mt. Misaka, Shimane Prefecture, Japan. *Oreorchis patens* grew along a small stream running through the forest or on the moist forest floor adjacent to the stream. The orchids were distributed scatteredly and in each growing site, one to several inflorescences which were exposed or partly covered with herbs were found.

A total of 6.67 hours over 2 days (May 16 and 17, 1997) were spent to observe 4–5 inflorescences in order to elucidate the fauna of flower-visiting insects and their intrafloral behavior, together with some additional observations. The blooming condition at that time already became off-peak and the flowers at lower positions of inflorescence had often withered. A part of flower visitors was netted for identification, and the number and position of pollinaria received by the insects were recorded. After the observation, 5 inflorescences were collected, and examined absence of pollinia at anther and deposition of pollinia onto the stigmatic surface on each flower. In addition, 45 inflorescences were randomly collected on May 28, and counted flower scars and young fruits on each rachis to estimate the percentage of pollinated flowers. For the latter samples, the position of each fruit was also recorded; then, all the fruits were removed from the rachises and kept into petri dishes under room condition until late June to confirm parasitism of agromyzid flies.

Results

Flower features in relation to pollination

The inflorescence of *O. patens* is an erect raceme with acropetally blooming flowers (Fig. 1). The subspreading flowers have faint, pleasant scent and their size usually becomes smaller acropetally. A

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whitish column with an incurved apex becomes thick at the base, and a concavity is formed on ventral surface. In the concavity, small amount of nectar is secreted. The inside and periphery of the concavity is orangy yellow, in contrast to the other portion of the column (Fig. 2). Sepals and lateral petals greenish yellow and labellum white, sometimes with dark red marks at the inner surface of lateral petals and labellum. Three-lobed labellum is connected to the column at the base with a flexible "hinge". The basal part of midlobe lightly covers the concavity of the column. Its anterior part is expanded, reflex, and marginally undulated. The callus along with the hinge at the basal midlobe may prevent flower visitors from stealing nectar through the side of the flower (see below). Two lateral lobes of the labellum are erect and rather small. A pollinarium consists of 4 yellow subglobose pollinia, a stipe, and a viscidium.

Flower visitors and their intrafloral behavior

A total of 8 species of insects, belonging to 4 orders, were recorded visiting the flowers of *O. patens* (Table 1). The most abundant visitor was a small syrphid fly *Melanostoma scalare* (Fig. 3), which appeared in the orchid patch to visit flowers 1.9 times per hour (13/6.67) on average. No long-tongued insects such as honey bees were recorded to visit the flowers during the observation period, except for an individual of a small cleptoparasitic bee *Nomada flavoguttata japonensis*. Out of the 8 species, only the above 2 species were recognized as vectors of *O. patens* pollinia; pollinaria-loading individuals of *M. scalare* and *N. flavoguttata* were found 6 times and once, respectively. All of them received pollinaria on the dorsal surface of the thorax (Fig. 4). The pollinaria did not always attach around the longitudinal median line of the thorax, and often stuck on the dorso-lateral surface. The number of pollinaria received per individual was 1–3 in *M. scalare* (n=3) and 2 in *N. flavoguttata* (n=1).

A few types of intrafloral behavior were observed in *M. scalare*. The syrphid fly usually landed on the tip of the labellum and then moved forward to take nectar. This behavior pattern was common to another syrphid fly *Cheilosia* sp., a small sweat bee *Lasioglossum* (*Evylaeus*) sp., and *N. flavoguttata*.

Table 1. Flower visitors of *Oreorchis patens* and their effectiveness as pollinators.

Species	Frequency appearing in orchid patch for flower visits	Occurrence of pollen removal and deposition
Diptera: Syrphidae		
Baccha sp. (not collected)	0.3	No
Cheilosia sp.	0.3	No
Melanostoma scalare (Fabricius)	1.9	Yes
Gen. sp. (not collected)	0.3	No
Hymenoptera: Halictidae		
Lasioglossum (*Evylaeus*) sp. (not collected)	0.4	No
Anthophoridae		
Nomada flavoguttata japonensis Tsuneki	0.1	Yes
Coleoptera: Cerambycidae		
Pidonia puziloi (Solsky)	–	No
Thysanoptera		
Gen. sp.	–	No

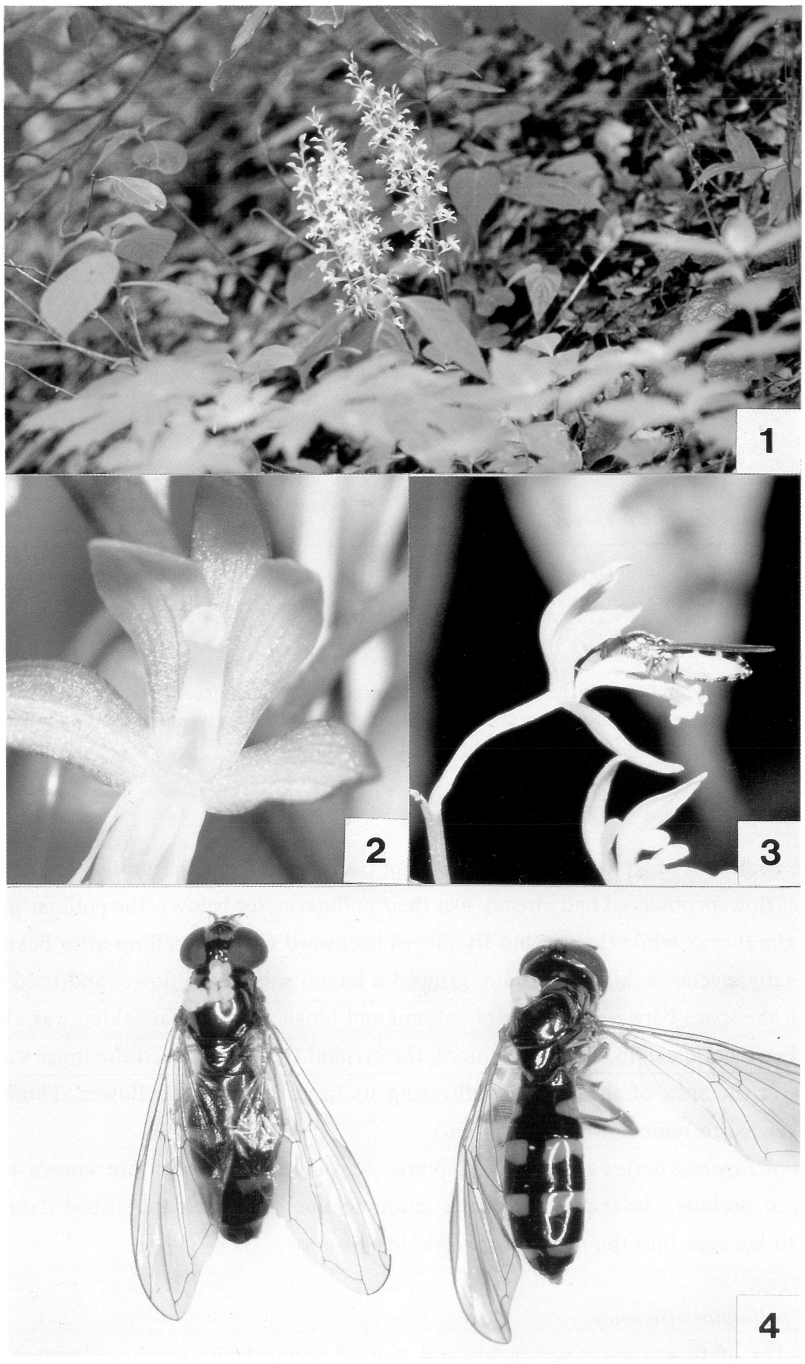

Fig. 1. The inflorescence of *Oreorchis patens*.

Fig. 2. The flower of *Oreorchis patens*. To show a concavity at the basal column, a hinged labellum is pushed down.

Fig. 3. A syrphid fly pollinator *Melanostoma scalare* visiting the flower of *Oreorchis patens*.

Fig. 4. *Melanostoma scalare* with pollinaria of *Oreorchis patens* on their thoraces.

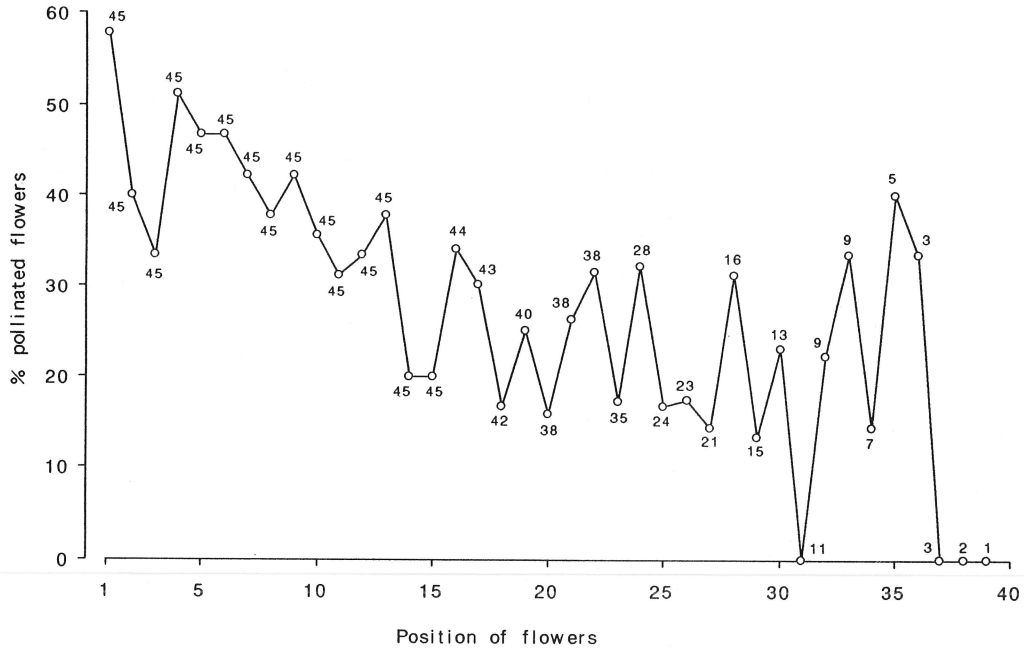

Fig. 5. The relationship between the position of the flowers of *Oreorchis patens* in an inflorescence and their estimated percentage of successful pollination. The position is given in ascending order, and the numerals in the graph indicate the number of flowers examined.

Although we could not observe how the pollinarium transferred from the anther to the syrphid fly (because most flowers observed had already lost their pollinaria; see below), the pollinarium presumably sticks to the thorax while the syrphid fly moves backward on the labellum after licking nectar.

Occasionally, nectar-seeking *M. scalare* gripped a lateral side of the flower and tried to insert its proboscis into the space between the base of column and hinge. Such nectar-taking was also observed in the sweat bee mentioned above. Furthermore, the syrphid fly rarely licked the inner surface of the lateral sepals, or the apex of the labellum directing its head outward the flower. Those intrafloral behaviors never led to remove the pollinarium.

Females of *Japanagromyza tokunagai* (Diptera: Agromyzidae), which are known to parasitize some species of orchids (Sasakawa personal communication, Sugiura unpublished data), appeared occasionally to lay eggs into the ovary of the orchid flowers.

Fruit set and pollinator efficiency

The number of flower scars per rachis and that of young fruits (=the estimated number of pollinated flowers per rachis) were 26.6±6.2 s. d. (n=50) and 8.4±3.7 (n=45), respectively. Mean young fruit set per rachis was 32.2% (range, 10.0-63.2; n=45), and each inflorescence examined had more than 2 fruits. The percentage of pollinated flowers (those with pollinia on their stigma) per rachis was 32.9% on average (range, 16.2-65.2; n=5), while the percentage of flowers without pollinia at anther per rachis attained 90.7% (range, 73.3-100.0; n=5). Within a single inflorescence, the percentage of pollinated flowers tended to be higher at lower positions of inflorescence (Fig. 5).

Up to early June, most of young fruits kept in petri dishes became blackish and almost empty due to heavy parasitism by the agromyzid flies. Finally, only 25 fruits kept their yellow-green color until mid June. Some fruits contained more than one larva (or puparium) of the fly. The adults eclosion occurred in mid to late June.

Discussion

The results strongly suggest that the flowers of *O. patens* are not regularly autogamous and pollinated usually by short-tongued insects, especially by small syrphid flies. So far as the present study site concerned, the main pollinator was *M. scalare* since it was the most abundant visitor received pollinaria. Nevertheless, *M. scalare* occasionally visited the orchid flowers to steal nectar. This phenomenon may indicate loose partnership between the plant and the insect. Indeed, the position of pollinaria stuck was rather unstable when the syrphid fly received them. Although no small sweat bees were confirmed to receive pollinaria during the survey, they might be secondary but effective pollinators, as a *Nomada* bee size of which was similar to the sweat bees was found to receive the pollinaria.

Flowers of *O. patens* possess the following remarkable features common to syrphid pollinating flowers of *Epipactis thunbergii* (Sugiura 1996), though the habitat of the both orchids are quite different (i. e., *E. thunbergii* usually occurs in open, sunny places). 1-The both flowers visually advertise the place of nectar reward to pollinators with the color of orangy yellow. And 2-The both have labellum with an elastic hinge (in *O. patens*, the role of the hinged labellum is not yet clarified). Despite of possible loose relationship, these shared features might imply that flowers of *O. patens* are pollinated by mainly syrphid flies.

The percentage of pollinated flowers per rachis in *O. patens* were moderately high but the final fruit set is lower (less than 32%) due to the parasitization by agromyzid flies. In *E. thunbergii*, the mean fruit set per rachis was 54.7% (Sugiura 1996).

In conclusion, the flowers of *O. patens*, which are characterized by nectar secretion into a concavity at basal column and by a hinged labellum, are pollinated mainly by small syrphid flies, and presumably also by small bees.

Acknowledgements

We are indebted to Dr. M. Sasakawa, Mr. Y. Haneda, and Mr. Y. Ikezaki for kindly identifying an agromyzid fly, a nomadine bee, and syrphid flies, respectively, and to Dr. K. Hoshikawa for his critical reading of the typescript. Our cordial thanks are also due to Miss. S. Yoshida and Mr. K. Takahashi for their kind help. Financial support for this work was provided in part by the Hoshizaki Green Foundation.

Summary

Pollination of an orchid *Oreorchis patens* was preliminarily studied on May and June of 1997 in a deciduous forest, Shimane, Japan. The flowers which are characterized by nectar secretion into a concavity at basal column and by a hinged labellum, were visited by 8 species of insects, and generally pollinated by short-tongued insects, especially by small syrphid flies. The main pollinator was a small

syrphid fly *Melanostoma scalare*, which appeared in the orchid patch studied, 1.9 times/hour on average. Pollinaria were always deposited on the thorax of pollinators. Young fruit set per rachis (i.e., the estimated percentage of pollinated flowers per rachis) was 32.2% on average, but this figure should decrease finally due to heavy parasitism by an agromyzid fly *Japanagromyza tokunagai.*

摘　　要

1997年の5-6月に島根県内の落葉樹林において，コケイランの受粉に関する予備的な調査を実施した。コケイランの花は，ずい柱基部の窪みに分泌される花蜜と可動性に富む唇弁という2点によって特徴づけられる。調査期間中，合計8種の訪花昆虫を記録した。送粉は，短吻性のアブ・ハチ類，特に小型のハナアブ類によって行なわれた。なかでも，ホシツヤヒラタアブは主要なポリネーターで，本種は1時間あたり平均1.9回の頻度でラン群落に飛来した。花粉塊は必ずポリネーターの胸部背面に付着していた。落花後まもない時期の着果率（送粉された花の割合）は，花茎あたり平均32.2%に達したが，最終的な着果率は，子房に寄生するランモグリバエの加害によって上記の値よりも低下すると推測された。

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