

Short Communication

Urocystis tranzscheliana*, a newly recorded smut fungus on *Primula sieboldii* from JapanMakoto Kakishima¹⁾, Yuko Yamazaki¹⁾, Yasushi Okayama²⁾ and Izumi Washitani²⁾¹⁾ Institute of Agriculture and Forestry, University of Tsukuba, Tsukuba, Ibaraki 305, Japan²⁾ Institute of Biological Sciences, University of Tsukuba, Tsukuba, Ibaraki 305, Japan

Accepted for publication 19 April 1995

A smut fungus on *Primula sieboldii* was newly found in Japan and identified as *Urocystis tranzscheliana* by comparative morphology. This species causes systemic infection of *P. sieboldii* and produces sori in its ovaries.Key Words—*Primula sieboldii*; smut fungus; *Urocystis tranzscheliana*; Ustilaginales.

Primula sieboldii E. Morren is a perennial clonal herb growing in a range of moist habitats throughout Japan. However, in recent years it has become rare and endangered due to habitat destruction by human activities (Washitani et al., 1991, 1994). We found a smut fungus developing sori in the ovaries of *P. sieboldii* in its habitats in Nagano Prefecture and Hokkaido, Japan. As there was no record of smut fungi on *Primula* spp. in Japan (Kakishima, 1982), we collected specimens and examined its morphology for identification.

In the surveys of smut infection of *P. sieboldii* at Nobeyama, Minamimaki-mura, Nagano Pref., we found that all ovaries of inflorescence developing from one ramet were infected with the fungus. Therefore, we considered that *P. sieboldii* was systemically infected with the smut fungus. However, there were no differences between infected and non-infected ramets in the morphology, number and blooming time of flowers. Further-

more, in external appearance it was difficult to detect infection because sori of the fungus were produced within ovaries and were covered by epidermis for a long time (Fig. 1A). However, black ustilospore masses of the fungus became easily discernible in the ovaries when the epidermis of ovaries was ruptured (Fig. 1B). This smut fungus is an important factor in reducing seed production of the infected plants of *P. sieboldii*.

In 1993, we examined the infection rate (ratio of infected ramets/non-infected ramets) in five populations of *P. sieboldii*, each consisting of ca. 300 to 500 ramets, at Nobeyama. Three of these populations showed infection, with infection rates of 0.16%, 7.01% and 9.40%, while no infection was found in two populations. *Primula sieboldii* is known as a heterostylous plant and has three floral types consisted of pin, thrum and homostyle morphs (Washitani et al., 1991, 1994). Infection rates were compared for these floral morphs with the flower-

Table 1. Morphology, host plants and distribution of *Urocystis* spp. on *Primula* spp.¹⁾

Species	Position of sorus	Spore ball		Dimension of spore (μm)	Host plant	Distribution
		Spore no.	Dimension (μm)			
<i>U. primulae</i>	Ovary	3–15	40–88 × 32–60	12–21 × 11–16	<i>P. acaulis</i> , <i>P. elatior</i> , <i>P. fistulosa</i> , <i>P. veris</i> , <i>P. officinalis</i> , <i>P. columnae</i>	Europe Russia
<i>U. primulicola</i>	Ovary	3–15	26–64 × 24–46	11–18.5 × 8–13.5	<i>P. farinosa</i> , <i>P. officinalis</i>	Europe
<i>U. tranzscheliana</i>	Ovary	1–8	21–55 × 12–34	15 × 13	<i>P. patens</i> (= <i>P. sieboldii</i>)	Russia (Ussuri Prov., Far East)
Present fungus	Ovary	1–7	22–50 × 15–34	10–20.5 × 7.5–15.5	<i>P. sieboldii</i>	Japan

¹⁾ Data of three *Urocystis* spp. were mainly taken from Zundel (1958) and Vanky (1985).

* Contribution No. 121, Laboratories of Plant Pathology and Mycology, Institute of Agriculture and Forestry, University of Tsukuba.

ing ramets identified as to their floral types at flowering time. However, we could not find significant differences in infection among these floral types. We suppose that fungal transmission from mother ramets to daughter ramets takes place systemically through stolons and newly infected ramets spread around original ones as reported by Wennstron and Ericson (1990). However, we think that ustilospores produced in the ovaries also play an important role in dissemination of the fungus and infec-

tion of the plant. Therefore, the infection mechanism by ustilospores should be clarified.

Specimens of *P. sieboldii* were examined by light and scanning electron microscopy. Spore balls composed of 1 to 7 (av. 3) ustilospores and these spore balls were completely covered by many sterile cells (Figs. 1C, D). Ustilospores were subglobose to broadly ellipsoidal or sometimes irregular and their walls were thick and dark brown. Dimensions of spore balls and ustilospores were

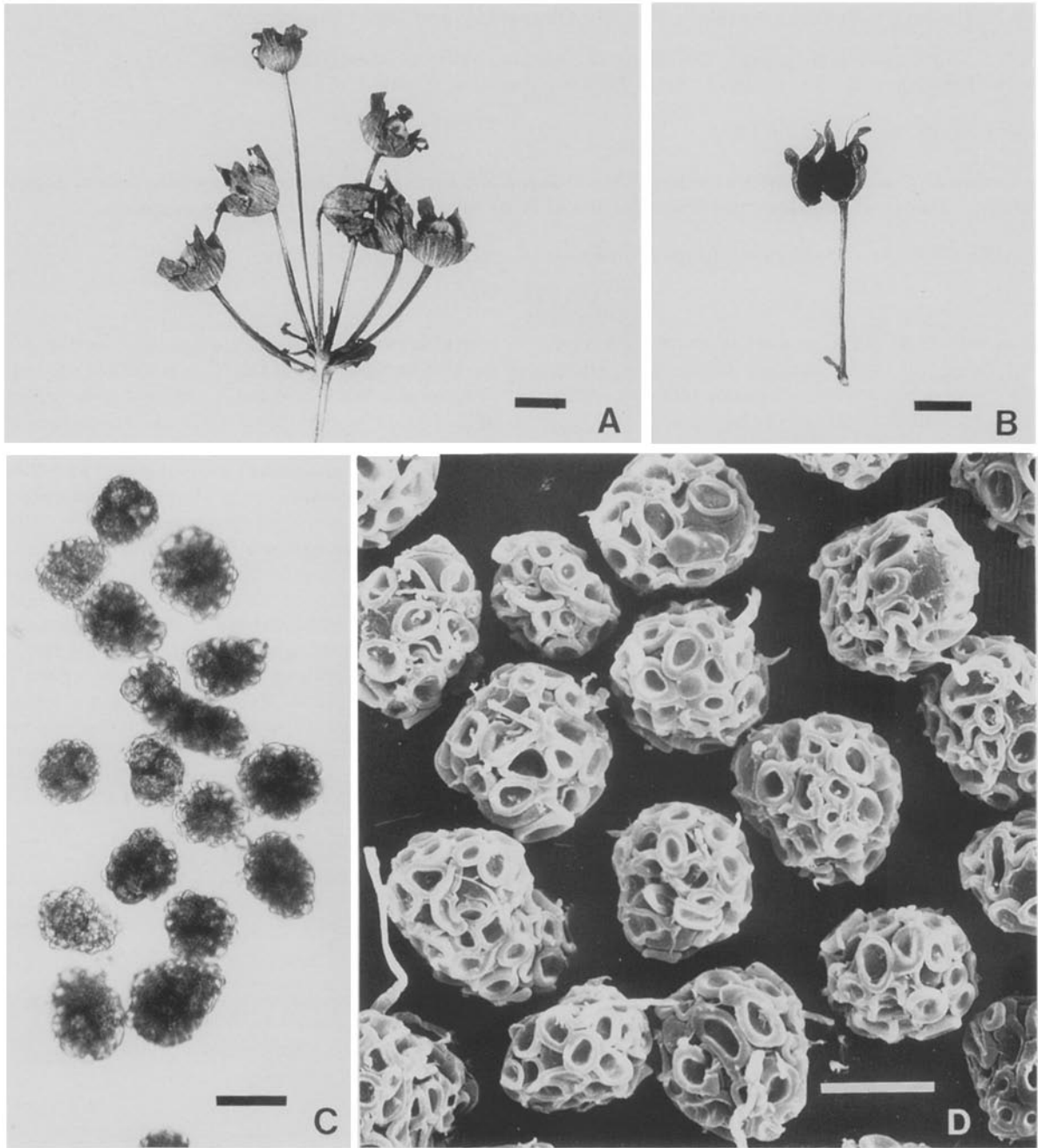


Fig. 1. *Urocystis tranzscheliana*.

A. Sori of the smut fungus produced in the ovaries of *Primula sieboldii*. It is very difficult to detect infection of the fungus from external appearance. B. A sorus of the fungus produced in an ovary of *P. sieboldii* and cut into halves. Black masses of spore balls fill the ovary. C. Spore balls covered by sterile cells. D. Dry spore balls observed under SEM. Spore balls are covered by collapsed sterile cells. (Scale bars: A, B = 5 mm; C = 30 μ m; D = 20 μ m.)

22-50 × 15-34 (av. 30-26) μm and 10-20.5 × 7.5-15.5 (av. 15 × 12) μm , respectively. These morphological characteristics show that this smut fungus belongs to the genus *Urocystis* (Kakishima, 1982; Vanky, 1987).

Three species of *Urocystis* parasitic on ovaries of *Primula* spp. have been reported, and their morphology, host plants and distribution are shown in Table 1. *Urocystis primulae* (Rostrup) Vanky and *U. primulicola* P. Magnus are parasitic on several species of *Primula* and are mainly distributed in Europe (Zundel, 1953; Vanky, 1985). These two species are morphologically similar to each other but the dimensions of spore balls and ustilospores of *U. primulicola* are smaller than those of *U. primulae*. On the other hand, *U. tranzscheliana* (Lavrov) Zundel is parasitic on *P. patens* Turcz. (= *P. sieboldii*) and reported only from Ussuri Prov., Far East, Russia (Zundel, 1953; Vánky, 1985; Govorova, 1990). This species is morphologically different from the former two species in spore number and dimension of spore balls. Spore balls and ustilospores of the smut fungus collected in Japan are morphologically very similar to those of *U. tranzscheliana*, and *P. sieboldii* is the host plant of both species. Therefore, we identified the smut fungus from Japan as *U. tranzscheliana*. This species was first described as *Tuburcinia tranzscheliana* Lavrov (1937) based on the specimen on *P. patens* collected near Voroshilov, Ussuri Prov., Far East, Russia, and then transferred to the genus *Urocystis* by Zundel (1953). Its description is as follows:

Urocystis tranzscheliana (Lavrov) Zundel, The Ustilaginales of the world, p. 335, 1953. Fig. 1
 ≡ *Tuburcinia tranzscheliana* Lavrov, Sist. Zаметki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kujbyševa 11: 3. 1937.

Sori in ovaries (seed pods), covered by epidermis; masses of spore balls, granular, powdery, black; spore balls composed of 1-7 (av. 3) ustilospores, completely covered by sterile cells, globose, ovoid, or elongated, 22-50 × 15-34 (av. 30 × 26) μm in diam; ustilospores sub-

globose to broadly ellipsoidal, or irregular, 10-20.5 × 7.5-15.5 (av. 15 × 12) μm in diam, walls thick, dark brown.

Specimens examined: On *Primula sieboldii* E. Morren, Nobeyama, Minamimaki-mura, Nagano Pref., Japan, July 1992, Y. Okayama, TSH-S1094; July 1993, Y. Okayama, TSH-S1095; 25 June 1994, M. Kakishima and Y. Okayama, TSH-S1096; July 1994, Y. Okayama, TSH-S1097; on *P. sieboldii*, Monbetsu-cho, Saru-gun, Hokkaido, Japan, 9 July 1993, I. Washitani, TSH-S1098.

All specimens examined have been deposited in the Mycological Herbarium of the Institute of Agriculture and Forestry, University of Tsukuba (TSH).

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