ハイマツに寄生するColeosporium pini-pumilaeの生活環

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Life cycle of *Coleosporium pini-pumilae* on *Pinus pumila*

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Abstract

The microcyclic life cycle of *Coleosporium pini-pumilae*, which is widely distributed in alpine areas of Japan on the needles of *Pinus pumila*, was demonstrated for the first time by an artificial inoculation experiment. When basidiospores produced from teliospores on the needles of *P. pumila* were inoculated onto new needles of *Pinus strobes* in July, abundant new telia developed on the inoculated previous year's needles in the next year without producing spermogonia. This result demonstrates that *C. pini-pumilae* has only the telial state in its life cycle. *Pinus strobus* is recorded as a new host plant of *C. pini-pumilae*.

***Key Words*: microcyclic *Coleosporium*, needle rust, pine.**

Introduction

Coleosporium pini-pumilae Azbukina was established by Azbukina (1968) based on a telial state that occurred on the needles of *Pinus pumila* (Pall.) Regel, a five-needled pine, collected in the Kamchatka peninsula of Far East Russia.

In Japan, the rust fungus was first recorded by Hiratsuka and Hiratsuka (1958) as *C. pinicola* Jackson based on a collection made in Daisetsu Mts., Hokkaido. Hiratsuka (1970) later adopted Azbukina's name. Kaneko (1981) reported the morphological characteristics of the fungus and its occurrence in several alpine areas of Honshu.

The rust fungus has been considered to be a microcyclic rust having only the telial state. However, its life cycle including the incubation period of the rust has not been demonstrated. This paper describes the result of an inoculation experiment with basidiospores of *C. pini-pumilae*.

Materials and Methods

Telia (Figs. 1 and 2) formed on the needles of *Pinus pumila*, were used as inocula. The telia had been collected by the author on Mt. Iwate, Iwate Pref., northern Japan, on 7 July,

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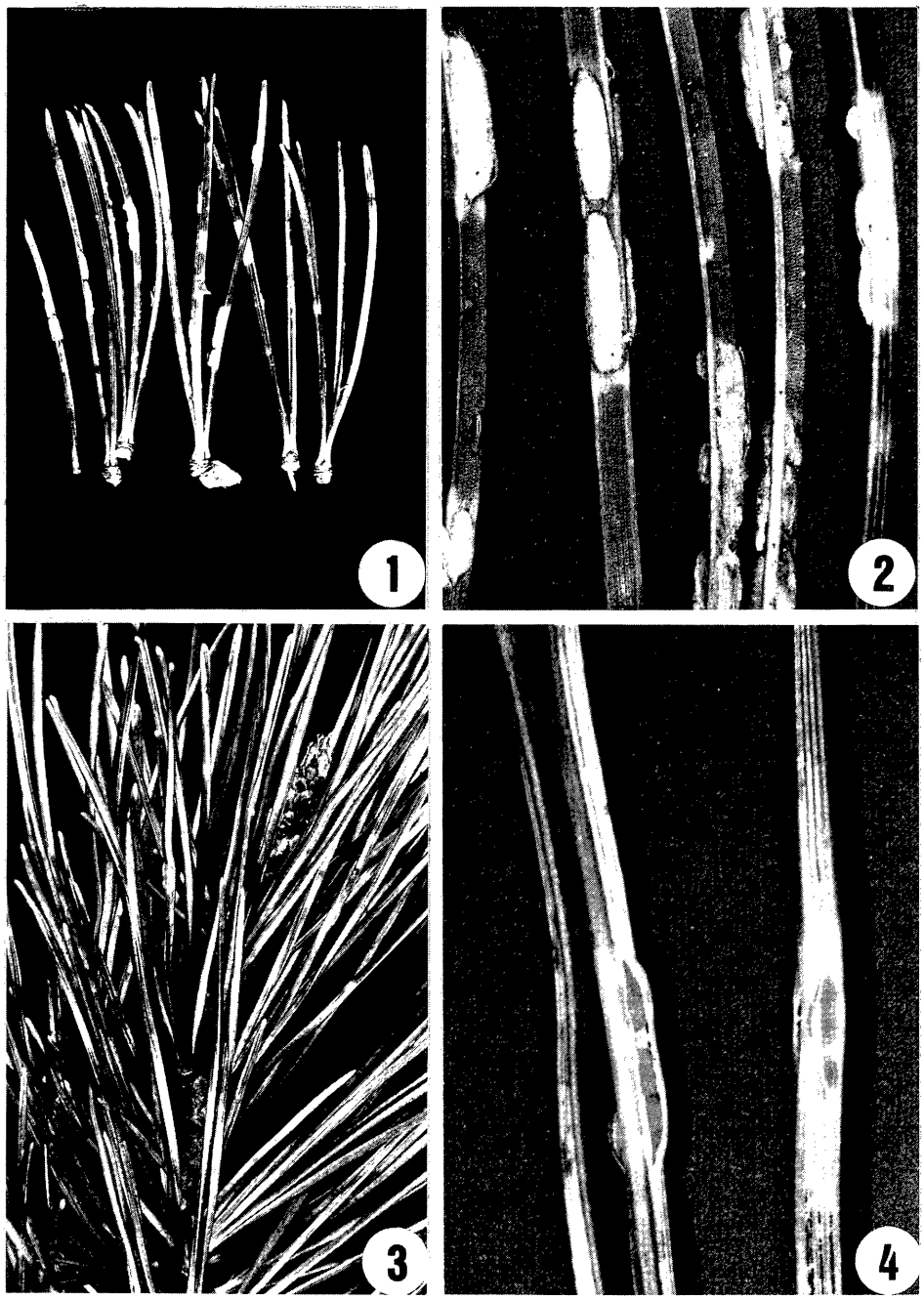
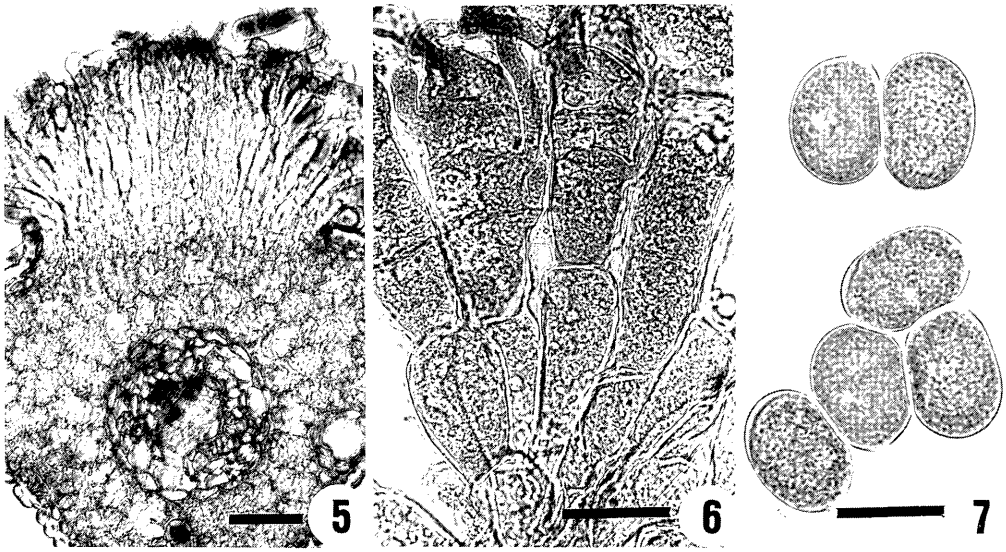


FIGS. 1 and 2. Telia of *Coleosporium pini-pumilae* on the needles of *Pinus pumila* collected on Mt. Iwate. FIGS. 3 and 4. Telia of *Coleosporium pini-pumilae* produced by the inoculation experiment on the needles of *Pinus strobus*.



FIGS. 5–7. *Coleosporium pini-pumilae* produced by the inoculation experiment on the needles of *Pinus strobus*. Fig. 5. Vertical section through a telium. Bar = 100 μm. Fig. 6. Teliospore chains. Bar = 30 μm. Fig. 7. Basidiospores. Bar = 20 μm.

1986. Inoculations were conducted at the Forest Pathology Laboratory of Tohoku Research Center, Forestry and Forest Products Research Institute in Morioka City, Iwate Pref. on 10 July, 1986. The rusted needles of *P. pumila* with telia were put on the needles of 5-year-old *P. strobus* L. and *P. densiflora* Sieb. & Zucc. seedlings planted in pots and allowed to produce basidiospores from the telia by being kept for four days in a moist chamber at 20°C in the dark. The inoculated pines were then transferred to a nursery and were checked periodically for symptom development. The nursery was free from the natural infection of *C. pini-pumilae*.

Results and Discussion

Yellowish minute spots appeared on both surfaces of the previous year's needles of *P. strobus* in March of the next year after the inoculation. Reddish-orange telia began to develop under the epidermis at the spots of the same needles in late April, then they matured on 13 May (Figs. 3 and 4). No spermogonia were produced before the appearance of the telia. The inoculated needles of *P. densiflora* remained uninfected. The morphological characteristics of teliospores (Figs 5 and 6) produced upon inoculation completely coincided with those on naturally infected *P. pumila*. When the teliospores were kept in a moist Petri dish, they produced basidiospores (Fig. 7).

These results demonstrate that *C. pini-pumilae* has only the telial state in its life cycle. The incubation period in this experiment, i.e., from infection with basidiospores to teliospore production, was 10 months. In the experiment, however, the pines were placed in the nursery of the institute after inoculation, which might have been warmer than the naturally distributed area of the rust fungus. Telia appear on one-

and two-year-old needles of *P. pumila* from July in the field. Therefore, the incubation period of *C. pini-pumilae* in the natural condition is regarded as one to two years depending on the climatic conditions.

Five microcyclic *Coleosporium* species are known throughout the world: *C. crowellii* Cummins and *C. pinicola* (Arth.) Jackson from North America, *C. himalayense* Durrieu from Nepal, *C. pini-densiflorae* Zinno & S. Kaneko from Japan (Zinno and Kaneko, 1984), and *C. pini-pumilae*. *Coleosporium pinicola* and *C. pini-densiflorae* occur on diploxylon pines, and the other three species on haploxylon pines. All the microcyclic *Coleosporium* species have truly catenulate teliospores. *Coleosporium pini-densiflorae* is morphologically distinguished from *C. pinicola* by the significantly thicker teliospores. The teliospores in the four-celled stage (metabasidia) of the three species on haploxylon pines including *C. pini-pumilae* do not possess a sterile cell at their base (Fig. 6) like most heteroecious *Coleosporium* species which produce their uredinia and telia on haploxylon pines (Kaneko, 1981). These three species on haploxylon pines are morphologically distinguishable from each other by the following characteristics. The teliospores of *C. crowellii* are smaller than those of the other two species. The width of the teliospores (one-celled probasidia and four-celled metabasidia) of *C. pini-pumilae* is apparently thicker than those of *C. himalayense*. Moreover, the basidiospores of *C. pini-pumilae* are extremely big (Fig. 7) compared to any other *Coleosporium* species.

Recently, Takahashi (1998) reported that this rust caused severe damage including immature defoliation of *P. pumila* on Mt. Asahidake, central Hokkaido.

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摘　　要

ハイマツに寄生する *Coleosporium pini-pumilae* の生活環

金子　繁

ハイマツの冬胞子葉さび病菌 *Coleosporium pini-pumilae* は，ハイマツの針葉に形成される冬胞子世代のみを有する短世代種と考えられていたが，その証明はなく，さらに精子器形成の有無，感染後の潜伏期間などは不明であった．岩手山の網張国有林で採取した冬胞子から形成された担子胞子によるストローブマツおよびアカマツ新葉への接種試験の結果，10 カ月後にストローブマツにのみ冬胞子が形成された．以上の結果，本種には精子器は存在せず，冬胞子世代のみをもつ短世代種であることが実験的に証明された．本実験では，被接種植物を平地の苗畑（盛岡市）に置いたため潜伏期間は 10 カ月であったが，自然発生地での観察から，潜伏期間は 2 年にわたる場合も多いと考察した．