Needle Blight of *Taxodium mucronatum* in the Philippines

Takao KOBAYASHI*

小林享夫*: フィリピンにおけるメキシコラクウショウ赤枯病

On September 1st of 1977, an occurrence of a severe needle blight disease was found on several potted seedlings of *Taxodium mucronatum* Ten. which were introduced from the United States in the previous year to Pacdal Forest Nursery, Luzon, Philippines. Many fruiting bodies of a species of *Cercospora* were observed on the blighted needles. Their morphological characteristics seemed to be very similar to those of *Cercospora sequoiae* Ell. et Ev., which has been known in Japan as the needle blight fungus of *Cryptomeria japonica* D. Don, *Sequoiadendron giganteum* Buchh. and *Taxodium distichum* Richard.

It is the purpose of this paper to confirm the similarity between two *Cercosporae* causing the needle blight of *Taxodium* in the Philippines and of *Cryptomeria* in Japan, and to give an additional evidence to the assumption that the needle blight fungus of *Cryptomeria* was introduced from the foreign country in the beginning of the 20th century.

Symptoms and signs Small and pale brown spots appear on needles, then spots become larger and brownish, usually extending the entire length of the needles. Affected needles are often curled and gradually defoliate. The disease attacks not only the needles but also current year's green shoots. Severely infected trees lose almost all of their needles and only a few green needles survive on the tops of current shoots. New needles are sprouted from the adventitious buds formed on bared shoots and twigs. They are again affected and the diseased needles gradually defoliate. On the blighted needles many powdery masses, greenish brown to grayish brown in color, are produced.

Morphology Stroma acicola, amphigenous, scattered, composed of pseudoparenchymatous cells, olive brown to dark brown or dark greenish brown, 40-90 μm in diam.; conidiophores brown to olive brown, paler toward the top, simple, curved or zigzag-shape, non- or 1-septate, 38-58 $\times$ 3-5 μm ; conidia pale olive brown to olive brown or greenish brown, obclavate, straight or curved, 2-8-septate, constricted at septa in aged stage, 38-80 $\times$ 4.5-7 μm , with many minute warts on the surface. (Fig. 1).

The fungus has unique conidia having two noticeable characters, one being the marked constriction and the dark coloration in aged conidia and the other being many minute warts on the surface of conidia. Among the genus *Cercospora*, a few species has been known in having either the dark conidia or warted conidia. *Cercospora sequoiae* is only species having dark conidia with many warts. It has been known to cause the needle blight of several conifers in Japan, Formosa and the United States^{1,2,3,4,5,6}. Morphologically, the

* Forestry and Forest Products Research Institute, P. O. Box 16, Tsukuba-Norin-Kenkyu-Danchi, Ibaraki 305, Japan 農林水産省林業試験場

1) Hodges, C. S. (1962). Mycologia 54: 62-69. 2) Ito, K., Shibukawa, K. and Kobayashi, T. (1952). Bull. Gov. For. Exp. Sta. 52: 79-152. 3) Ito, K., Shibukawa, K. and Kobayashi, T. (1958). J. Jap. For. Soc. 40 (9): 407-410. 4) Ito, K., Kobayashi, T. and Shibukawa, K. (1967). Bull. Gov. For. Exp. Sta. 204: 73-90. 5) Sawada, K. (1928). Rept. Dept. Agr., Gov't. Res. Inst. Formosa 35: 107-108. 6) Zinno, Y. (1969). J. Jap. For. Soc. 51 (7): 183-187.

Philippine fungus was quite identical with *Cercospora sequoiae*. (Table 1).

Isolation Monoconidial isolation of the fungus produced very similar colonies to those of the *Cercospora sequoiae* originated from *Cryptomeria japonica*. Colonies grew 20 to 30 mm in diam. after one month of incubation at 25 C. They are dark green to blackish green and are covered with white to grayish white aerial mycelia. They did not produce any conidia on agar media, but abundant conidia were produced on sclerotial bodies obtained by Zinno's procedure⁷⁾.

Pathogenicity Mycelial suspensions were used for inoculum in two inoculation experiments conducted in 1978, and conidial suspensions for 1979's test. Inoculum suspensions were sprayed on one-year-old and 2-year-old seedlings of *Cryptomeria japonica*. Inoculated seedlings were kept under moist condition for 48 hours at 20-30 C. Results of the inoculation tests are given in Table 2. Needle blight developed after 30 days of incubation and severe disease development as observed in the field was recorded after 2 months of incubation in 1979's test. No difference was recognized between two isolates originated from

Fig. 1. *Cercospora sequoiae* Ell. et Ev. on *Taxodium mucronatum*

a: Stroma and conidiophores, b: Young conidia without wart, c: Mature conidia with warts, d: Aged conidia with constriction (scales: 10 μ m)

Table 1. Dimensions of Cercosporae on *Taxodium*, *Sequoiadendron* and *Cryptomeria*

Fungus (Locality)	Host	Conidiophore (μ m)	Conidium	
			Size (μ m)	Septum
<i>Cercospora</i> sp. (Philippines)	<i>Taxodium mucronatum</i>	38-50 $\times$ 3-5	45-73 $\times$ 4.5-7	4-9 a)
	<i>Cryptomeria japonica</i> *	40-58 $\times$ 4-5	38-80 $\times$ 4.5-6.5	2-6 a)
<i>Cercospora sequoiae</i> (Japan)	<i>Cryptomeria japonica</i> *	30-55 $\times$ 4-5	38-80 $\times$ 4.5-6.5	2-5 a)
	<i>Cryptomeria japonica</i>	40-80 $\times$ 4-6	30-85 $\times$ 5-9	2-7 b)
	<i>Sequoiadendron giganteum</i>	55-70 $\times$ 5-8	37-53 $\times$ 5-7	3-5 c)
	<i>Taxodium distichum</i>	31-88 $\times$ 4-5	39-88 $\times$ 5-7	3-10 d)

* Inoculated seedlings. a) The author b) Ito *et al.* (1952)²⁾ c) Ito *et al.* (1958)³⁾ d) Zino (1969)⁶⁾

Table 2. Pathogenicity of *Taxodium*- and *Cryptomeria*-isolates to *Cryptomeria*-seedlings

Inoculum isolate Experiment	CC—136 ^{a)}		CC—85 ^{b)}		Control	
I (VIII- 7, 1978)	3/3 ^{c)}	+ ^{d)}	3/3	+	0/2	—
II (VIII-13, 1978)	3/3	+	3/3	+	0/2	—
III (IX - 8, 1979)	4/4	+++	4/4	+++	0/4	—

a) From *Taxodium mucronatum* of the Philippines.

b) From *Cryptomeria japonica* of Japan.

c) Denominator: number of inoculated seedlings, Numerator: number of positive infection.

d) Degree of disease development and production of fruiting bodies, +: slight, +++: heavy or numerous.

Taxodium (CC-136) and from *Cryptomeria* (CC-85), not only in their pathogenicity to *Cryptomeria*-seedlings but also in the dimensions of their fruiting bodies produced on the inoculated needles (Table 1).

Identification The *Cercospora* causing the needle blight of *Taxodium mucronatum* in the Philippines was identified with *C. sequoiae* Ell. et Ev. on the bases of quite identity to the latter in its morphological characteristics and pathogenicity to *Cryptomeria*-seedlings as shown in Tables 1 and 2.

Discussion The needle blight fungus of *Taxodium mucronatum* in the Philippines was identified as *Cercospora sequoiae*. It was introduced from the United States with its host plants *Taxodium* to the Philippines. On the other hand, a species of *Cercospora* has been well known in Japan as the most virulent pathogen to *Cryptomeria japonica*. It causes severe needle blight of the seedlings. No record of the disease occurrence has been found before the 20th century, nevertheless the cultivation of *Cryptomeria*-seedlings from seeds has been continued as early as the 16th century^{4,8,9)}. The causal fungus was first named *Cercospora cryptomeriae* Shirai¹⁰⁾ as indigenous to Japan, but it was later proved to be the same as American species, *Cercospora sequoiae*, through the comparative cultural, morphological and etiological studies with Japanese and American specimens and isolates⁴⁾.

From these facts, Ito *et al.*⁴⁾ assumably concluded that *Cercospora sequoiae* had been introduced from the United States to Japan at the beginning of the 20th century with the susceptible exotic conifers, and that it soon became prevalent on Japanese susceptible host, *Cryptomeria japonica*. Their assumption was supported here by an additional fact that *Cercospora sequoiae* is introducing at present from the United States to the Philippines with its susceptible host, *Taxodium mucronatum*.

Acknowledgement The author expresses his heartfelt thanks to the Staff members of RP (Republic of the Philippines)-Japan Afforestation Project in the Pantabangan area, for their courtesy to give the author the chance to observe the forest diseases in the Philippines during the stay there as technical consultant.

(Received January 7, 1980)

8) Ito, K. (1967). For. Prot. News 16(6): 122-126.

9) Ito, K. (1969). Pl. Prot. 23(5): 207-210.

10) Kitajima, K. (1916). Bot. Mag. 30: 411-414.

Explanation of Plate

- A: Needle blight of *Taxodium mucronatum* caused by *Cercospora sequoiae*.
- B: Diseased needles of *Taxodium mucronatum* caused by *Cercospora sequoiae*.
- C: Conidium of *Cercospora sequoiae* on *Taxodium mucronatum*.
- D: Stroma of *Cercospora sequoiae* on *Cryptomeria japonica* inoculated with *Taxodium*-isolate.
- E: Conidia of *Cercospora sequoiae* on *Cryptomeria japonica* inoculated with *Taxodium*-isolate.
- F: Stroma of *Cercospora sequoiae* on *Cryptomeria japonica* inoculated with *Cryptomeria*-isolate.
- G: Conidium of *Cercospora sequoiae* on *Cryptomeria japonica* inoculated with *Cryptomeria*-isolate.