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## Foot Rot of Ulluco Caused by Pythium aphanidermatum

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## ABSTRACT

Severe rot of stem bases caused by *Pythium aphanidermatum* was found on ulluco (*Ullucus tuberosus*) grown in Kagawa Prefecture, Japan, in September 1999. The name "foot rot of ulluco" is proposed for this new disease.

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Key words : new disease, Pythium aphanidermatum, foot rot, ulluco.

Ulluco (*Ullucus tuberosus* Caldas) is a perennial tuber crop of the family Basellaceae indigenous to the South American Andes. Cultivation trials and breeding for its domestication in Japan are now being conducted<sup>2</sup>). Severe rot of stem bases caused by *Pythium aphanidermatum* (Edson) Fitzpatrick was found on the crop grown in trial fields located in Kagawa Prefecture, Japan, in September 1999. The name "foot rot of ulluco" is proposed for this new disease, together with the description in detail here. An outline of this paper was published elsewhere<sup>4</sup>).

**Symptom** Water-soaked lesions initially appeared on stem bases (Fig. 1A), gradually enlarging toward upper parts of the stems and to lower leaves. The affected parts of plants softened and turned dark brown, resulting in early rot. The diseased plants collapsed to the ground and died early (Fig. 1B). White mold appeared on the lesions under moist conditions.

Pathogen In culturing the single hyphal isolates (UP1 and UP2) from the visible mold on hemp seed agar (HSA) at 25°C in the dark, hyaline and aseptate hyphae  $4-10 \ \mu m$  in width elongated to form cottony colonies (Fig. 1C). On the 3-day-old colonies placed at 5°C in the dark for 12 hr, oogonia, antheridia, oospores and hyphal swellings (zoosporangia) differentiated (Fig. 1D, E, F, G). Oogonia were terminal, smooth, bearing one oospore per oogonium and 22-30  $\mu$ m in diam. Antheridia were terminal or intercalary, monoclinous or diclinous, and  $6-12 \,\mu m$ in size. Frequencies of terminal-diclinous, terminalmonoclinous, intercalary-diclinous and intercalary-monoclinous antheridia were 82%, 12%, 0% and 6% in 100 antheridia observed, respectively. Terminal antheridia paragynously fused to oogonia. Oospores were aplerotic and 18-24  $\mu$ m in diameter. Zoosporangia were lobate and inflated. When zoosporangia soaked in the petri solution at 20-25°C over 30 min, zoospores were released (Fig. 1H). Vesicles and encysted zoospores were 18-26 (-32)  $\mu$ m and 8-10  $\mu$ m in diameter, respectively. When the isolates were cultured on potato dextrose agar (PDA) at 5-42°C in the dark, they grew at 10-41°C to form cottony colonies similar to those on HSA. The PDA colonies at 35°C (opt. temp.) and 40°C grew 71-78 mm and 51-65 mm in diameter per day, respectively. The isolates were identified as *P. aphanidermatum* based on morphological and cultural characters in the previous works<sup>3,5,6)</sup>.

Inoculation test and disease name Four to eight healthy potted seedlings of Peruvian strain of ulluco were inoculated with one of the following isolates; UP1, UP2 and a tomato isolate TP1 of P. aphanidermatum. Two to three agar pieces (about 1.0-2.0 cm<sup>2</sup> per piece) from 3-day-old PDA colonies grown at 25°C in the dark were placed around the stem base per healthy seedling. Four to eight healthy seedlings were simultaneously treated with aseptic PDA to serve as controls. The inoculated seedlings and controls were covered with polyethylene bags and kept in a glasshouse at 26-30°C for 2 days. The experiment was carried out twice for both 3-week-old and 5-week-old seedlings. One day after inoculation, watersoaked lesions developed, surrounding stem bases at inoculation points, then turned brown and the plants rotted. All diseased plants collapsed 3 days after inoculation, then entirely withered within 1 week after inoculation (Fig. 1I). On the other hand, control plants were healthy. The isolates were consistently re-isolated from diseased plants, but not from healthy controls, demon-

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Fig. 1. Symptoms of foot rot of ulluco and the pathogen, P. aphanidermatum. A, B: Symptoms of natural infection (A: Enlargement of rotten stem; B: Collapsed, diseased plant with rotten foot). C-H: Morphology of the pathogen, P. aphanidermatum (C: Colonies of isolate UP1 on HSA at 25°C in the dark for 3 days [upper: surface side; lower: reverse side]; D-F: Aplerotic oospore in an oogonium with a terminal-diclinous antheridium (D), with an intercalary-monoclinous antheridium (E), with a terminal-monoclinous antheridium (F) [bar: 20 μm]; G: Lobate, inflated zoosporangium [bar: 40 μm]; H: Zoosporangium differentiating a vesicle and zoospores [bar: 10 μm]). I: Diseased ulluco seedling 4 days after inoculation with isolate UP1 (right) and healthy control plant (left). J: Tomato seedlings with damped off 5 days after inoculation with isolate UP1 (upper pots) and healthy control plant (lower pots).

strating that the isolates were pathogenic to ulluco. The isolates, including TP1 on 3-week-old seedlings of tomato (cv. House Odoriko), were also confirmed to cause damping off (Fig. 1J). Basellaceae is a new host family for *P. aphanidermatum. Pythium ultimum* Trow has been reported to cause "tuber leak" and/or "foot rot" on ulluco<sup>1)</sup>. The name "foot rot (koshiore-byô in Japanese)" is proposed for the present new disease because of the identical symptoms caused by both species.

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