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Fruit Soft Rot of Sweet Persimmon Caused by *Mucor piriformis* in Korea

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A fruit soft rot caused by *Mucor piriformis* occurred on sweet persimmon storages in Jinju, Changwon and Gimhae, Gyeongnam province, Korea, 2003. The disease infection usually started from wounding after cracking of fruits. At first, the lesions started with water soaked and rapidly softened and diseased lesion gradually expanded. Colonies on potato dextrose agar at 20°C were whitish to olivaceous-buff. Sporangia were globose, black and 96~153 μm in size. Sporangiophores were 26~42 μm in width. Sporangiospores were ellipsoid and 5.8~10.6 × 4.3~7.6 μm in size. Columella was obovoid, cylindrical-ellipsoidal, pyriform, subglobose and 80~125 μm in size. Optimal temperature for mycelial growth was 20°C on PDA. The causal organism was identified as *M. piriformis*. This is the first report of fruit soft rot on sweet persimmon caused by *M. piriformis* in Korea.

KEYWORDS: Fruit soft rot, *Mucor piriformis*, Sweet persimmon

Postharvest diseases develop on plant produce or plant products during harvesting, grading and packing, during transpotation to market and to the consumer, and while the products are in the possession of the consumer until the moment of actual consumption or use. *Mucor* mainly occurs during sale after harvest, transports, marketshelf and storage when moisture conditions are favorable. The soft rot on the succulent, freshy fruits and vegetables, cut flowers, bulbs and corms are often affected by postharvest diseases (Agrios, 1997). *Mucor* is omnipresent as a saprophyte and sometimes as a weak parasite on stored organs of plants. When the epidermal cells are collapsed, the fungus emerges through the wounds, fruit drop, step on fruit and cracks of matured fruits of sweet persimmon, and produces aerial sporangiophores and sporangia. Probably not a primary pathogen or perhaps non-pathogenic but frequently associated with diseased conditions. Sooty molds of persimmon caused by other fungi such as *Aureobasidium pullulans*, *Capnophaeum fuliginodes*, *Microxyphium* sp., *Scorias communis*, *Tripospermum juglandis* and *Alternaria* sp. have also been reported (Kitagima, 1989; Kishi, 1998; The Phytopathological Society of Japan, 2000). Although, *Mucor* sp. has reported as the pathogen of *Panax giseng* Meyer, *M. piriformis* on sweet persimmon during storage has not been reported in Korea (The Korean Society of Plant Pathology, 1998).

Symptom. The infected parts of wounded and cracks on matured fruits appeared water soaked at first, then became soften. Gray hyphae grew from the site where the fungus invaded primarily and covered the affected portions by

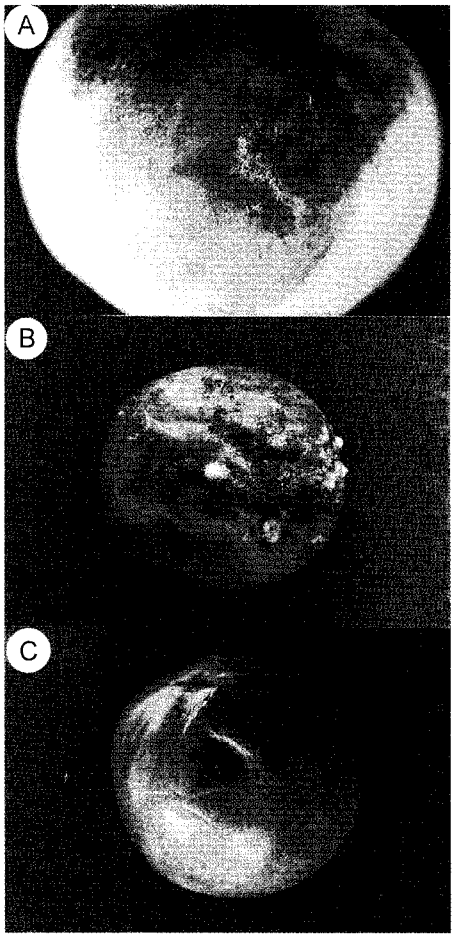

Fig. 1. Symptoms of fruit soft rot on sweet persimmon fruits. A: Typical symptom showing water-soaked lesion from crack of matured fruits in the reservation, B: Fruits rotted severely in storage, C: Artificially inoculated fruits 7 days after inoculation.

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producing tuft whiskerlike gray sporangiophores and sporangia (Fig. 1A). The infected tissues finally broke down and disintegrated in watery rot. Fruits soft rot severely in storage throw into the discard (Fig. 1B).

Disease occurrence. *M. piriformis* mainly occurs during transports, marketshelf and storage after harvest. Disease infection usually started from wounding after cracking of fruits. At first, the lesions started with water soaked and rapidly softened and infected area lesion gradually expanded. In the March of 2003, a disease suspected as *Mucor* soft rot occurred on sweet persimmon (*Diopyros kaki* var. *domestica* Makino) (cv. Fuyu) in Jinju, Changwon and Gimhae, Gyeongnam province, Korea, The infection rate of the disease in some storage containers reached to 3.8%. *M. piriformis* attacked only cracks of matured fruits, however, it occurs occasionally on young and immatured sweet persimmon, and diseased fruits were collected from in the containers. The causal organism was isolated from mycelial tips on the diseased fruits. Whiskerlike gray fungal colonies were formed on potato dextrose agar at 20°C in the dark. Sporangia and sporangiophores were carefully observed under the light microscope (400×).

Mycological characteristics. The fungal colonies grown on potato dextrose agar at 20°C were whitish to olivaceous-buff, and became heavily speckled with the appearance of sporangia (Fig. 2A, Table 1). The size and width of the sporangia, sporangiophores, sporangiospores and columella were measured with on image analysis program (Image pro 4.0). Sporangia were small, globose, unequal, erect or incurved and were 96~153 μm in size. The color was white to yellow at first and then turned yellowish brown to black when it matured. The sporangia contained thousands of oval sporangiospores. Sporangiophores were the taller with short lateral branches and the shorter sympodially branched and were 26~42 μm in size and (Fig. 2B, 2C). Sporangiospores were ellipsoid, smooth, greyish in mass and were 5.8~10.6 × 4.3~7.6 μm in size (Fig. 2E). Most of the sporangiospores were appeared to be readily dispersed in the air. Numerous sporangiospores were produced on the diseased fruits. Columella was 80~125 μm variable in size and shape, and brownish in color, obovoid, cylindrical-ellipsoidal, pyriform, subglobose in shape (Fig. 2D). Rhizoid formed on PDA (Fig. 2F). Chlamydospores were absent. The maximum temperature for mycelial growth of the was 30°C, minimum temperature 5°C and optimum growth tempera-

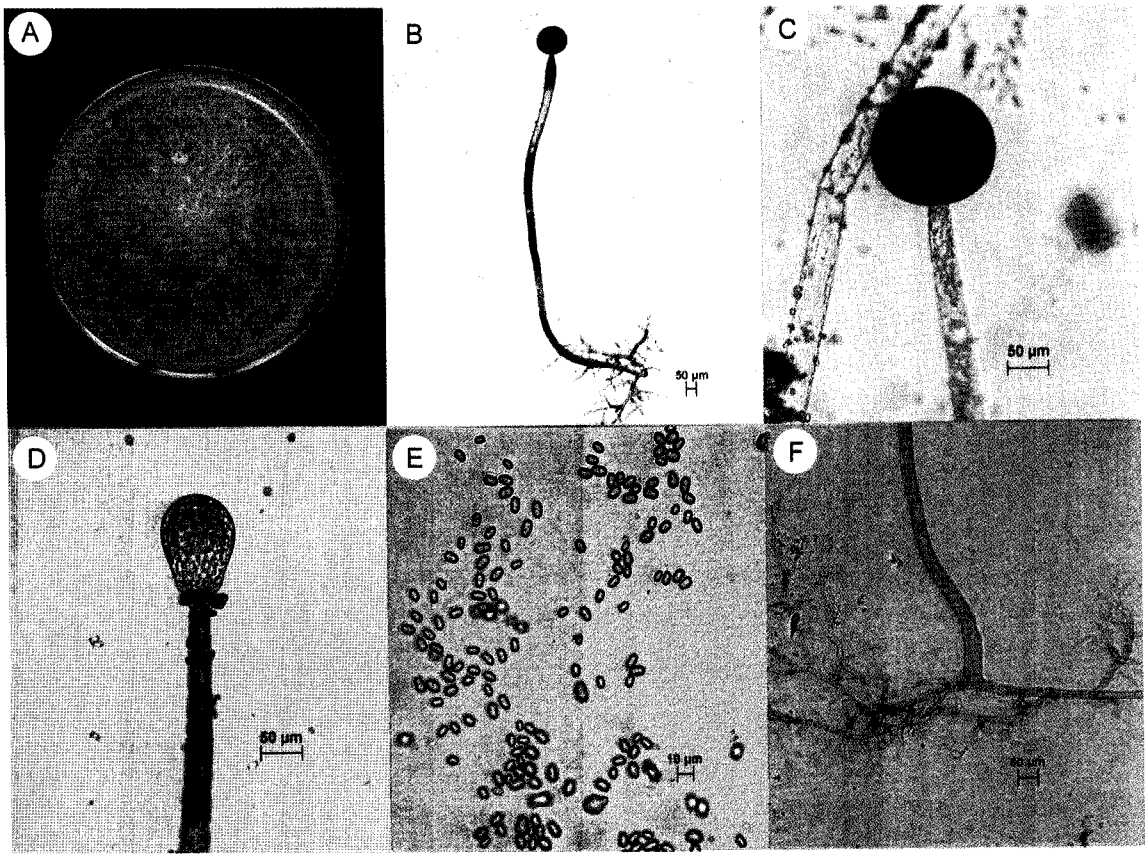

Fig. 2. Morphological characteristics of the pathogenic fungus, *Mucor piriformis*. A: Mycelial growth on PDA after 48 hours, B: Typical sporangiophore and sporangium with rhizoid, C: Sporangium and sporangiophore. D: Columella, E: Sporangiospores, F: Rhizoid.

Table 1. Comparison of morphological characteristics of the pathogenic fungus isolated from soft rotted sweet persimmon fruit with *Mucor piriformis* described previousely

Characteristics	Present study	Domsch *et al*[a]
Colony		
color	whitish to olivaceous-buff	whitish to olivaceous-buff
Sporangiophores		
shape	shorter sympodially branched	shorter sympodially branched
size	26~42 μm wide	40 μm wide
Sporangia		
color	black	blackish
shape	globse	–
size	96~153 μm diam	300 μm diam
Sporangispores		
shape	ellipsoid	ellipsoid
size	5.8~10.6 × 4.3~7.6 μm	7~9.5 × 4~7 μm
Columella		
shape	obovoid, cylindrical-ellipsoidal, pyriform, subglobose	obovoid, cylindrical-ellipsoidal, pyriform, subglobose
size	80~125 μm	170~150 μm
Chlamydospores	absent	absent

[a]Described by Domsch *et al.* (1980).

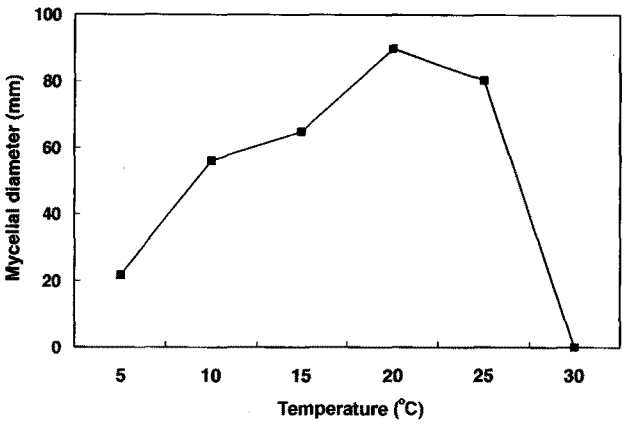

Fig. 3. Effect of temperature on the mycelial growth of *Mucor piriformis*, the causal organism of fruit soft rot of sweet persimmon. Linear mycelial growth was measured 48 hours after incubation on PDA. Data are means of three replications (■—■).

ture was 20°C (Fig. 3). Most morphological characteristics of the fungus examined in this study were almost identical to *M. piriformis* described by the previous workers (Sarbhoy, 1966; Lunn, 1977; Domsch, *et al.*, 1980). Accordingly, we identified the causal fungus of fruit soft rot of sweet persimmon as *M. piriformis* Fischer.

Pathogenicity test. The conidial suspension of 50 *ml* was sprayed to cracked sweet persimmon (cv. Fuyu). Inoculated fruits were placed in a humid chamber with 100% relative humidity at 20°C for 24 hours. The typical symptoms on sweet persimmon were appeared at 7 days after inoculation in plastic fruit container (Fig. 1C).

The disease infection usually started from cracked parts of fruits. The symptoms were identical to those of naturally infected sweet persimmon. Morphological characteristics of conidia and mycelia of the fungi reisolated from inoculated fruits were same as that of naturally infected fruits.

Farr *et al.* (1995) have reported the postharvest diseases caused by *Mucor circinelloides*, *M. hiemalis*, *Mucor* sp. in persimmon. To protect fresh fruits from wounding during harvest, transportation and storages is most important to avoid the fungal infection. Taguchi *et al.* (2001) have isolated *Alternaria*, *Cladosporium*, *Fusarium*, *Penicillium*, *Pestalotiopsis* and *Phoma* from persimmon fruits. Two of them, *Pestalotiopsis foedans* and *Pestalotiopsis longiseta* were proved pathogenic to persimmon. Kwon *et al.* (2003) reported 8 kinds of pathogens, *Alternaria* sp., *Botrytis* sp., *Cladosporium* sp., *Colletotrichum* sp., *Mucor* sp., *Penicillium* spp., *Phomopsis* sp., and *Pestalotia* sp., in sweet persimmon during storages. Recently, Kwon and Park (2003) have reported *Cladosporium cladosporioides* and *Penicillium crustosum* as causal agents of fruit rot after harvest.

Identification of the causal fungus of fruit soft rot on sweet persimmon fruits was confirmed by Centraalbureau voor Schimmelcultures (CBS) in The Netherlands. Further confirmation of the fungal identification was done in the Korean Agricultural Culture Collection (KACC), National Institute of Agricultural Biotechnology, Rural Development Administration, Suwon, Korea. Environmental conditions such as low temperature and humidity during the storage season of sweet persimmon are favorable for *M. piriformis* to penetrate fruit tissues through wounds incurred during transport, storage and marketing.

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