

Fruit rot of sweet pepper caused by *Stemphylium lycopersici* in Japan

Keisuke Tomioka · Toyozo Sato

Received: 23 June 2011 / Accepted: 5 September 2011 / Published online: 28 September 2011
© The Phytopathological Society of Japan and Springer 2011

Abstract A severe rot of postharvest fruits of sweet pepper, a variety of *Capsicum annuum*, was found in Kagawa Prefecture in southwestern Japan in August 1999. A fungus, isolated repeatedly from the diseased fruits and identified as *Stemphylium lycopersici*, was demonstrated to be pathogenic to fruits of sweet pepper. The disease was new to Japan, and the fungus was added to the pathogens causing fruit rot of *C. annuum*.

Keywords Fruit rot · Postharvest · Sweet pepper · *Capsicum annuum* var. *grossum* · *Stemphylium lycopersici*

Introduction

Sweet pepper (*Capsicum annuum* L. var. *grossum* Sendtner) is one of several important varieties of *C. annuum* (Solanaceae) (Hirose 2004). Severely rotting postharvest fruits were found during an examination of their quality as perishables in Zentsuji City, Kagawa Prefecture in southwestern Japan in August 1999. We isolated and identified the causal pathogen and inoculated fruits of sweet pepper with the isolate to confirm its pathogenicity. Part of this paper was presented elsewhere (Tomioka et al. 2002; Tomioka and Sato 2004a, b).

Symptoms and pathogen

The disease was found on postharvest fruits, which had been stored in polyethylene bags (5–10 fruits/bag) or open plastic containers (10–20 fruits/container) at 10–15°C with a relative humidity of 80–95% for 10–20 days. Brownish to blackish, depressed lesions gradually enlarged and softened, rotting the entire fruit (Fig. 1a). The lesions seemed to enlarge and spread to adjacent healthy fruits. A dark gray to dark brown, velvety mold, consisting of conidiophores and conidia of the pathogen, appeared on the lesions under moist conditions. Conidiophores were mononematous without branches, 1–5 septate, brown, entirely verruculose, with swellings at distal ends, 40–140 µm long, 4–8 µm wide, 6–10 µm at the swellings, developing by percurrent proliferation (Fig. 1b). Conidia were holoblastic, singly formed at the apices of conidiophores, not chained, cylindrical, obclavate to oblong, multiseptate to look muriform with constrictions at 1–3(–4) major transverse septa, rounded to conical at the apices, entirely and densely verruculose, brown, 54–60 × 16–21 µm in size, and with a length to breadth ratio (L/B) of 2.7–3.4 (average 3.1) (Fig. 1c). These fungal characters on the host were reconfirmed in the pathogenicity test described later, using a representative isolate, SS1, obtained by single-conidium isolation from a lesion of a diseased fruit. When isolate SS1 was cultured on potato dextrose agar (PDA) at 25°C in the dark, it formed dark olivaceous colonies with grayish aerial mycelia, secreting a yellowish to reddish brown pigment into PDA (Fig. 1d). Conidiophores and conidia developed from colonies grown on PDA under black light (Toshiba FL20SBLB, peak emission 352 nm). The conidiophores tended to be longer than those on the lesions, and the conidia tended to be somewhat rounded at the apices and smaller than those on the lesions. Conidial L/B ratios

K. Tomioka and T. Sato contributed equally to this work.

K. Tomioka (✉) · T. Sato
National Institute of Agrobiological Sciences,
Tsukuba 305-8602, Japan
e-mail: tomioka@affrc.go.jp

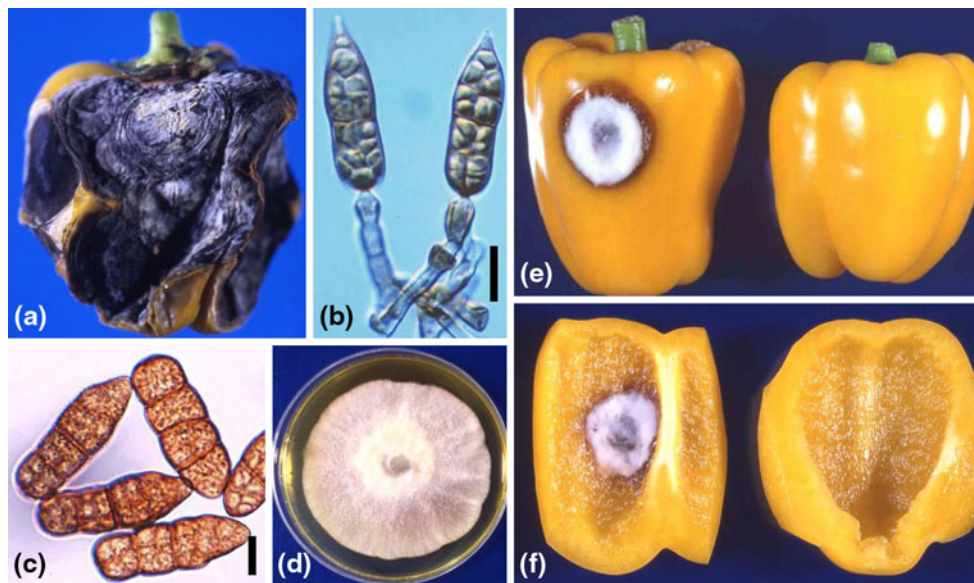


Fig. 1 Symptoms of fruit rot on sweet pepper and morphology of causal fungus, *Stemphylium lycopersici*. **a** Natural symptoms, rotting of fruit with black mold. **b**, **c** Conidiophores and conidia from lesion after natural infection. **b** Conidiophores and young conidia (bar 10 μ m); **c** Mature conidia (bar 10 μ m). **d** Colony of isolate SS1

grown on PDA at 25°C in the dark for 6 days. Exterior (**e**) and interior (**f**) of rotted fruits 10 days after wound-inoculation with isolate SS1 in test 1 (left) and those of healthy fruits 10 days after nonwound-inoculation with isolate in test 2 (right), respectively

were sometimes less than 3. The isolate grew on PDA plates in the dark at 5–38°C with maximum growth of 4.3 mm/day at 25°C. Chlamydospores, sclerotia and telomorphs were not found. The morphological and cultural characters of the isolate agreed well with descriptions of *Stemphylium lycopersici* (Enjoji) W. Yamam. (Ellis 1971; Enjoji 1931; Saito et al. 1970; Tomioka et al. 1997; Yamamoto 1960), and we identified the isolate as *S. lycopersici*. Isolate SS1 was deposited in Genebank, National Institute of Agrobiological Sciences as accession MAFF238863.

Pathogenicity

Postharvest fruits of a breeding line of sweet pepper were inoculated with isolate SS1 by two methods. Conidia were collected from 14-day-old PDA cultures grown at 25°C under black light, then suspended in sterilized distilled water at 4×10^4 conidia/mL. The conidial suspension was dropped onto pinpricked points on three healthy fruits (test 1) and intact surface of other three healthy fruits (test 2). In each test, two healthy fruits were also treated with sterilized distilled water in the same way as controls. All treated fruits including controls were kept in a moist chamber controlled at 24–26°C. Symptoms were reproduced on all fruits inoculated in test 1 (Fig. 1e, f). Water-soaked, brownish, depressed lesions appeared 3 days after inoculation. The lesions enlarged and softened, eventually rotting the entire fruit.

Controls had no symptoms. The isolate was consistently reisolated from diseased fruits, but not from healthy controls, demonstrating that the isolate was pathogenic to sweet pepper fruits. In test 2, no symptoms developed, and the isolate was not reisolated. Since wounded fruits appear to be more susceptible to the pathogen than intact fruits, avoidance of wounding postharvest fruits will be effective to control the fruit rot.

Leaf spot, leaf blight and/or fruit rot of *C. annuum* by some *Stemphylium* species such as *S. botryosum* Wallroth (Braverman 1968; Deena and Basuchaudhary 1984; Murata 1916), *S. capsici* (Wang and Zhang 2006), *S. lycopersici* (Kim et al. 2004; Saito et al. 1970) and *S. solani* GF Weber (Kim et al. 2004; Kranz 1962, 1965) have been reported. The diseases caused by *S. lycopersici* have been found in Korea and Japan (Kim et al. 2004; Saito et al. 1970). A disease in Japan called “*Stemphylium* leaf spot” or “hakuhan-byo” (white leaf spot in Japanese) (Saito et al. 1970) did not cause lesions on fruits. This report is the first of *S. lycopersici* as a causal pathogen of fruit rot of *C. annuum* in Japan.

References

- Braverman SW (1968) A new leaf spot of pepper incited by *Stemphylium botryosum* f. sp. *capsicum*. *Phytopathology* 58:1164–1167
- Deena E, Basuchaudhary KC (1984) Studies on seed-borne mycoflora of chilli. *Indian Phytopathol* 37:151–153

- Ellis MB (1971) Dematiaceous hyphomycetes. Commonwealth Mycological Institute, Kew
- Enjoji S (1931) Two diseases of tomato (2) (in Japanese). J Plant Prot 18:48–53
- Hirose T (2004) *Capsicum* L. In: Tsukamoto Y (ed) The grand dictionary of horticulture (compact version) (in Japanese). Shogakukan, Tokyo, pp 1574–1577
- Kim B-S, Yu SH, Cho H-J, Hwang H-S (2004) Gray leaf spot in peppers caused by *Stemphylium solani* and *S. lycopersici*. Plant Pathol J 20:85–91
- Kranz J (1962) A list of fungi new to Cyrenaica (Libya). Sydowia 16:125–134
- Kranz J (1965) A list of plant pathogenic and other fungi of Cyrenaica (Libya). Phytopathol Pap 6:1–24
- Murata J (1916) Diseases of chili and their control (1) (in Japanese). Nihon Engei Zasshi 30:5–9
- Saito M, Kurata M, Yamamoto I (1970) Studies on *Stemphylium* leaf spot of green pepper (in Japanese with English summary). Bull Kochi Inst Agr Forest Sci 3:1–8
- Tomioka K, Sato T (2004a) *Fusicoccum aesculi*, *Phomopsis phomoides*, *Fusarium lateritium* and *Stemphylium lycopersici* causing fruit rot of sweet pepper. In: Watanabe MM, Suzuki K, Seki T (eds) Innovative roles of biological resource centers. Japan Society for Culture Collections & World Federation for Culture Collections, Tsukuba, Japan, p 641
- Tomioka K, Sato T (2004b) Virulence of *Fusicoccum aesculi*, *Phomopsis phomoides*, *Fusarium lateritium* and *Stemphylium lycopersici* to sweet pepper fruits. In: National Institute of Agrobiological Sciences (ed) Genetic and functional diversity of agricultural microorganisms, 12th NIAS international workshop on genetic resources. Tsukuba, Japan, pp 119–120
- Tomioka K, Sato T, Sasaya T, Koganezawa H (1997) Leaf spot of kalanchoe caused by *Stemphylium lycopersici*. Ann Phytopathol Soc Jpn 63:337–340
- Tomioka K, Sato T, Fujino M (2002) *Stemphylium lycopersici* and *Fusarium lateritium* causing fruit rot of sweet pepper (abstract in Japanese). Proc Assoc Pl Prot Shikoku 37:71
- Wang Y, Zhang X-G (2006) Three new species of *Stemphylium* from China. Mycotaxon 96:77–81
- Yamamoto W (1960) Synonymous species of *Alternaria* and *Stemphylium* in Japan (in Japanese). Trans Mycol Soc Jpn 2:88–93