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Short Communication

Parasitic specialization of *Geotrichum candidum* citrus race

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Parasitic specialization of *Geotrichum candidum* citrus race, the causal agent of citrus sour rot, was investigated. Of seven isolates tested for pathogenecity, all could infect ten species of citrus fruits and edible parts of five species of noncitrus crops. Only one isolate (Ap2), isolated from soil of an apple orchard, could infect apple fruit.

Key Words——*Geotrichum candidum* citrus race; parasitic specialization.

Geotrichum candidum Link is a fungus that can cause disease in man, animals and plants (Butler, 1960; Butler et al., 1965; Carmichael, 1957; Tubaki, 1978). Isolates of *G. candidum* either from citrus fruits or soils have been found to be pathogenic to the fruits of tomato, orange, lemon, satsuma mandarin, grapefruit, cucumber and carrot (Aoki, 1992; El-Tobshy and Sinclair, 1965; Kitajima, 1989; Suprapta et al., 1995). The isolate which exhibits pathogenecity to citrus fruit (the cause of citrus sour rot) was designated as *G. candidum* citrus race (Butler et al., 1965). Suprapta et al. (1995) reported that *G. candidum* citrus race is widely distributed in soil of citrus groves and noncitrus fields in Japan. This suggested that susceptibility to infection by *G. candidum* citrus race may not be limited to lemon, orange and satsuma mandarin, but may include other citrus fruits and/or edible parts of noncitrus crops.

Seven isolates of *G. candidum* citrus race isolated from soils in Japan, namely S31, S148, S178, S209 (from citrus groves), Tm2 (from tomato field), Gr3 (from vineyard) and Ap2 (from apple orchard), were artificially inoculated into 10 species of citrus fruits and edible parts of 16 species of noncitrus crops (Table 1). All fruits and edible parts of crops for inoculation were obtained from the market. Inoculation was carried out as described previously (Suprapta et al., 1995). Three to five fruits or edible parts of noncitrus crops per species were inoculated with each isolate. The inoculated fruits were incubated for 5 d in the dark at 25°C.

Of seven isolates tested, all were pathogenic on all 10 species of citrus fruits and edible parts of 5 species of noncitrus crops, and one isolate (Ap2) was also pathogenic on apple fruits. Watery soft-rot symptoms were generally observed, though variations in symptoms were observed among infected fruits (Fig. 1). Iyokan and ponkan showed water-soaked lesions with sparse arthrospores on the surface (Figs. 1A, B). This type of symptom was occurred on lemon, satsuma mandarin, orange, grapefruit, sour orange and Meiwa kumquat. Pumelo and apple developed brown lesions (Figs. 1C, E), while netted-melon showed a water-soaked lesion with slight cracking (Fig. 1D). Similar symptoms were also observed on sweet pepper, Japanese persimmon and carrot. Tomato developed soft-rot symptoms followed by severe cracking with abundant arthrospores on the surface (Fig. 1F). Variation in lesion diameter was also observed among isolates and species of fruits (Table 1). Isolate S31 seemed to be the most pathogenic of the seven isolates tested, and lemon fruit was most susceptible to the citrus sour rot pathogen.

All seven isolates tested failed to infect cucumber, egg-plant, European grape, kiwi, onion, Japanese pear, peach, potato, daikon and sweet potato (Table 1). Some isolates of *G. candidum* were reported to be pathogenic to peach fruit, while some isolates were nonpathogenic (Butler, 1960). Of our seven isolates, all failed to infect peach fruit. Potato was reported to be immune to infection with *G. candidum* (Butler, 1960), and our findings supported this. El-Tobshy and Sinclair (1965) reported that nine isolates of *G. candidum* isolated from either orange or lemon fruits were pathogenic to tomato, orange, lemon, grapefruit and carrot, but squash was not infected by these isolates. The pathogenicity of *G. candidum* citrus race to tankan, ponkan, iyokan, sour orange, Japanese persimmon, sweet pepper and apple are reported here for the first time. From this study, we conclude that susceptibility to infection by *G. candidum* citrus race is not limited to lemon, orange or satsuma mandarin fruits, but includes other species of citrus fruits and edible parts of noncitrus crops.

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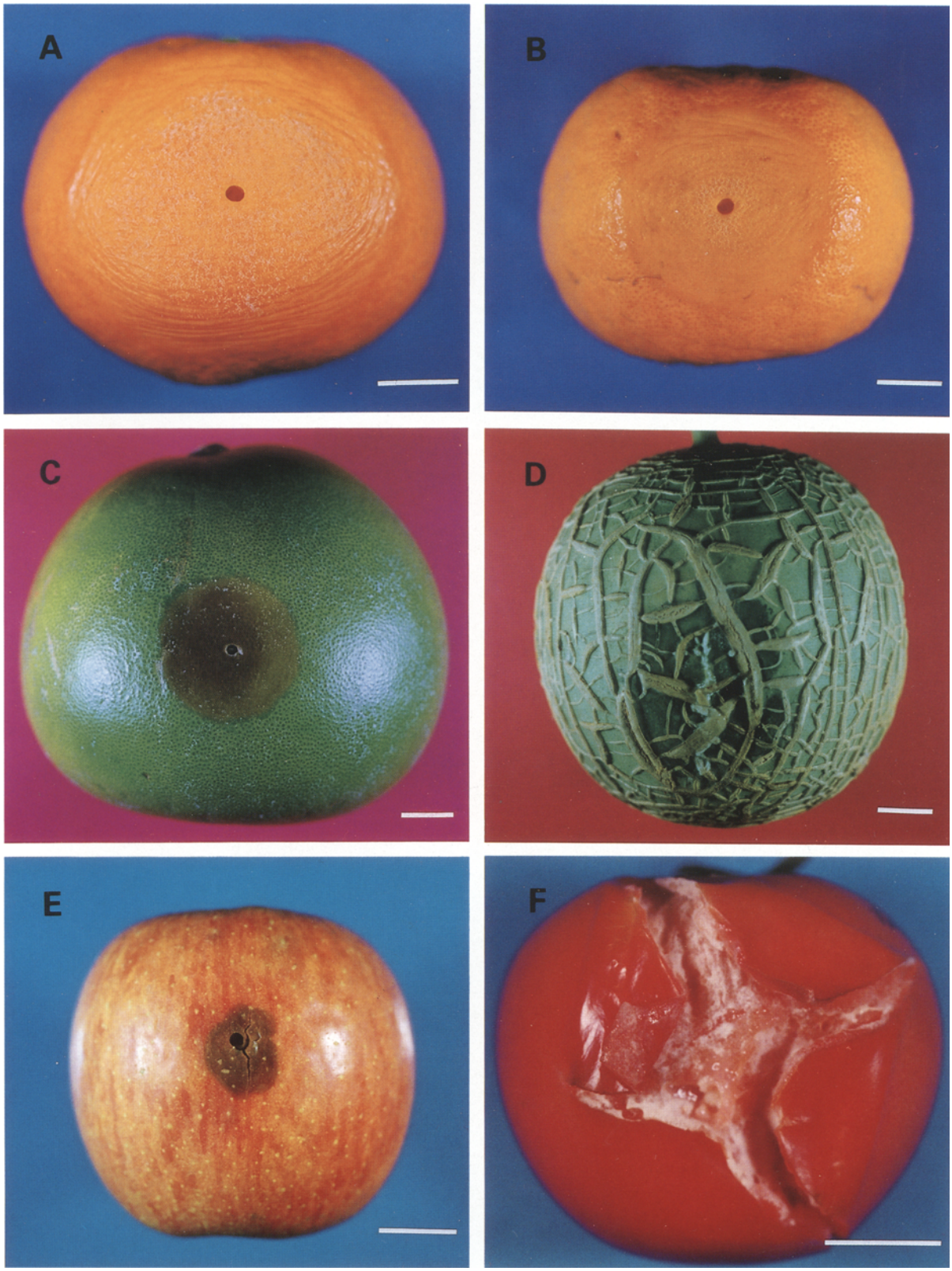

Fig. 1. Symptoms of sour rot on several fruits inoculated artificially with *G. candidum* citrus race isolate S31. A. Iyokan, B. Ponkan, C. Pummelo, D. Muskmelon, E. Apple, F. Tomato. Scales represent 15 mm.

Table 1. Pathogenicity of seven isolates of *G. candidum* citrus race on citrus fruits and edible parts of noncitrus crops.

Species[a]	Isolate and host reaction[b]						
	S31	S148	S178	S209	Tm2	Gr3	Ap2
1. Lemon (*Citrus limon* Burm.f.)	+++	+++	+++	+++	+++	+++	+++
2. Sweet orange (*Citrus sinensis* Osbeck)	+++	+++	++	++	+++	++	+
3. Satsuma mandarin (*Citrus unshiu* Marc.)	+++	++	++	++	+++	++	++
4. Iyokan (*Citrus iyo* Hort. ex Tanaka)	+++	+++	++	+++	+++	++	++
5. Ponkan (*Citrus reticulata* Blanco)	++	+	++	++	++	+	+
6. Tankan (*Citrus tankan* Hayata)	++	+	++	++	++	++	++
7. Pumelo (*Citrus grandis* Osbeck)	++	+	+	+	++	+	+
8. Grapefruit (*Citrus paradisi* Macfad.)	+++	++	++	++	++	++	+
9. Sour orange (*Citrus aurantium* L.)	+++	++	++	++	+++	++	++
10. Meiwa kumquat (*Fortunella margarita* Swingle)	++	++	++	++	++	++	++
11. Carrot (*Daucus carota* L. var. *sativus* Hoffm.)	++	++	++	++	++	+	+
12. Sweet pepper (*Capsicum annuum* L. var. *angulosum* Mill.)	++	++	++	+	++	+	+
13. Tomato (*Lycopersicon esculentum* Mill.)	+++	++	+++	++	+++	++	++
14. Japanese persimmon (*Diospyros kaki* Tunb. ex Murray)	+	+	+	+	+	+	+
15. Netted melon (*Cucumis melo* L. var. *reticulatus* Ser.)	+++	++	++	++	++	++	++
16. Apple (*Malus pumila* Mill. var. *domestica* Schneider)	−	−	−	−	−	−	+
17. Cucumber (*Cucumis sativus* L.)	−	−	−	−	−	−	−
18. Eggplant (*Solanum melongena* L.)	−	−	−	−	−	−	−
19. European grape (*Vitis vinifera* L.)	−	−	−	−	−	−	−
20. Kiwi (*Actinidia chinensis* Planch.)	−	−	−	−	−	−	−
21. Onion (*Alium cepa* L.)	−	−	−	−	−	−	−
22. Japanese Pear (*Pyrus serotina* Rehder var. *culta* Rehder)	−	−	−	−	−	−	−
23. Peach (*Prunus persica* Batsch var. *vulgaris* Maxim.)	−	−	−	−	−	−	−
24. Potato (*Solanum tuberosum* L.)	−	−	−	−	−	−	−
25. Daikon (*Raphanus sativus* L. var. *longipinnatus* L. H. Baclay)	−	−	−	−	−	−	−
26. Sweet potato (*Ipomoea batatas* Lam.)	−	−	−	−	−	−	−

a) Three to five fruits or edible parts of crops were inoculated with each isolate.
b) Host reaction was determined 5 after inoculation by measuring the mean diameter of lesion. −: no infection, +: lesion diam 5−25 mm, ++: lesion diam 26–45 mm, +++: lesion diam 46 mm or more.

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