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First Report of Sour Rot on Post-harvest Oriental Melon, Tomato, Cucumber, Potato, Pumpkin and Carrot Caused by *Geotrichum candidum*

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During survey of postharvest diseases of vegetables in the middle region of Korea in 2003, 2004 and 2005, new disease symptoms showing watery rot and soft rot were observed. In this study, the disease causal agents were identified as *Geotrichum candidum*, and their host range and pathogenicity were investigated. *G. candidum* isolated had wide host range and strong pathogenicity against carrot, cucumber, tomato and pumpkin. The disease occurrence on several vegetables that *G. candidum* can be a serious threat to stable production of fresh vegetable.

***Keywords* : *Geotrichum candidum*, Postharvest, Sour rot**

During survey of postharvest diseases of vegetables in the middle region of Korea in 2003, 2004 and 2005, new disease symptoms showing watery rot and soft rot were observed. The disease symptoms were found on oriental melon, tomato, radish, potato and carrot. The disease casual agents were isolated and inoculated to confirm their pathogenicity. Initial symptoms were appeared as water-soaked lesions and white mycelia formation on infected parts. When plant tissues were affected, out layers of rind were intact but inner parts were decayed completely. And then out layer of rind were cracked. The isolated casual agents were identified based on cultural, mycological and bio-chemical characteristics by comparing with those of two representative type cultures, *Geotrichum candidum* KACC41323 and *Geotrichum* species KACC40367 given from Korean Agriculture Culture Collection (KACC). The cultural, mycological and bio-chemical characteristics of the present isolates were very similar with those of *Geotrichum* species (Table 1). The present isolates formed hyaline, smooth, one-celled, subglobose to cylindrical arthroconidia. The arthroconidia were quite variable in size. On trptic soy agar, colonies were fast growing, flat, white to cream, dry and finely suede-like with no reverse pigment. Hyphae were hyaline, septate, branched and break up into chains of hyaline, smooth, one-celled, subglobose to cylindrical arthroconidia (Fig. 1). Odor like it from apple was strongly given off on the present isolates-cultured agar.

In order to identify precisely the isolated yeast at species level, utility of carbon and nitrogen sources were investigated using Biolog YT microplate. As a result, all the isolates tested were identified as *Geotrichum candidum* with similarity at the range of 42 to 76% (Table 2). Finally we identified the six isolated yeasts as *G. candidm.* In order to confirm host range and pathogenicity of the six newly-identified *G. candidum* isolates, ten vegetable crops including potato, sweet potato, carrot, melon and oriental melon were inoculated with conidial suspension of each *G. candidum* isolates. The present *G. candidum* isolates caused typical symptoms on the challenged vegetables (Fig. 2).

Pathogenicity of *G. candidum* tested showed high differences among the isolates. *G. candidum* OM-1 isolate from oriental melon showed high pathogenicity against tomato, cherry tomato and pumpkin, but no pathogenicity against oriental melon. To-1 isolate from tomato showed a little pathogenicity to tomato, cherry tomato and oriental melon. HY-1 isolate from radish showed pathogenicity to cucumber, oriental melon, tomato and cherry tomato. HY-5 isolate from potato had wide host range and showed pathogenicity to potato, carrot, cucumber, tomato, cherry tomato and pumpkin. B-34 isolate from carrot showed pathogenicity

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Table 1. Cultural, mycological and biochemical characteristics of the two representative isolates *Geotrichum* sp. and *G. candidum*, and the present isolates obtained from postharvested vegetables in Korea

Characteristics	Representative isolates[a]		Present isolates[b]				
	Gs	Gc	OM-1	TO-1	HY-1	HY-5	B-34
Intense smell (Pineapple)	+	+	+	+	+	+	+
Rapidly growing	+	+	+	+	+	+	+
White and dry mycelium	+	+	+	+	+	+	+
Powdery to cottony colonies	+	+	+	+	+	+	+
Not grow at 37	–	–	–	–	–	–	–
Spore size (μm)	6.5/2.9	5.6/2.2	6.2/3.1	6.2/2.7	6.3/3.1	6.3/3.5	6.5/3.0
Mycelium width (μm)	6.7	7.6	7.1	6.7	7.5	8.0	6.6
Optimal Growth temperature (°C)	25–28	25–28	25–28	25–28	25–28	25–28	25–28
Growth on sole carbon source (1%, w/v)							
Glucose	–	+	+	+	+	+	+
D-Galactose	–	+	+	+	+	+	+
Glycerol	–	+	+	+	+	+	+
D-manitol	–	+	+	+	+	+	+

[a]Gs, *Geotrichum* sp.; Gc, *Geotrichum candidum.*
[b]OM-1, TO-1, HY-1, HY-5, and B-34 were isolated from harvested oriental melon, tomato, radish, potato and carrot, respectively.

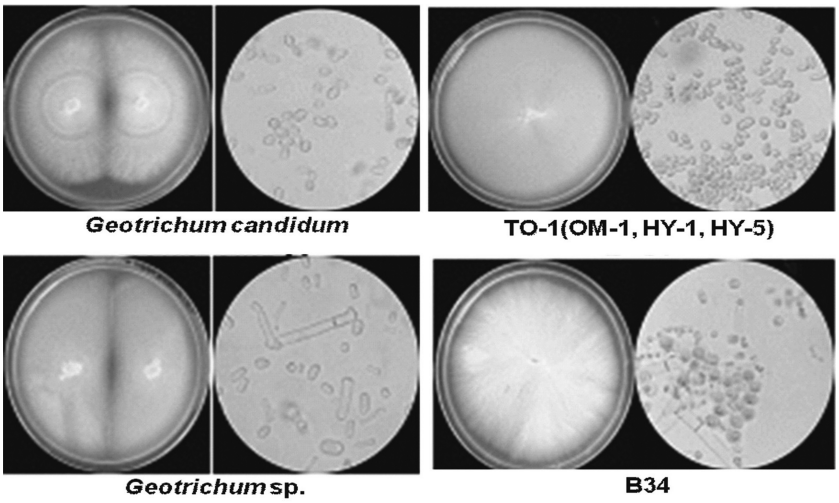

Fig. 1. Morphological characteristics of the two representative isolates, *G. candidum and Geotrichum* species and the present isolates of *Geotrichum* obtained from harvested vegetables. Left and right plates of each figure represent colony pattern and arthroconidia formed on tryptic soy agar after five day-incubation.

Table 2. Identification, similarity index and nearest species for six yeast isolates obtained from harvested vegetables according to Biolog microstation (YT microplate) for yeast identification

Isolates	Host	Identification	Similarity (%)	Closest species
OM-1	Cucumber	*G. candidum*	62	*Candida sorbophila*
To-1	Tomato	"	70	*C. sorbophila*
HY-1	Radish	"	76	*C. rugosa B*
HY-5	Potato	"	76	*C. sorbophila*
B-34	Carrot	"	99	*C. sorbophila*

to carrot, cucumber, oriental melon and pumpkin. Consequently there was big difference in host range and pathogenicity among *G. candidum* isolates from different vegetable crops (Table 3).

In this study, isolates OM-1 and HY-1 isolated from harvested oriental melon and radish were not pathogenic to oriental melon and radish in pathogenicity test of seven days, respectively. The reason is not clear and I think, further study for its elucidation will be needed.

Until now, few reports on sour rot caused by *G. candidum* has been reported only on citrus fruit in

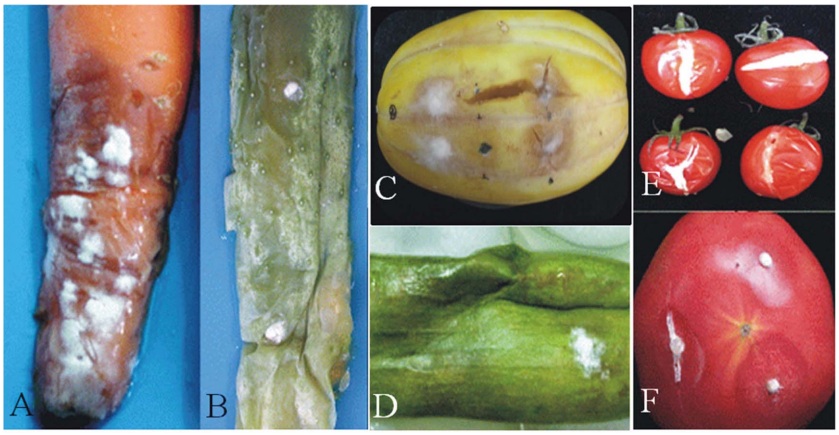

Fig. 2. Typical symptoms of watery rot formed on carrot, cucumber, pumpkin, oriental melon, cherry tomato and tomato when they were inoculated with *Geotrichum candidum* isolate B34 (**A** and **D**), isolate OM-1 (**B** and **C**) and isolate To-1 (**E** and **F**). B-34, OM-1 and TO-1 were isolated from harvested carrot, oriental melon and tomato, respectively.

Table 3. Pathogenicity of *Geotrichum candidum* isolated from stored vegetables and potato

Crop	Pathogenicity[a] of *Geotrichum candidum* isolated from different crops						
	Gs	Gc	OM-1[b)]	To-1	HY-1	HY-5	B-34
Potato	±	–	–	–	–	+	±
Sweet potato	±	–	±	±	–	–	–
Carrot	+++	+	–	+	–	+++	++
Melon	–	+	±	±	±	±	–
Radish	–	±	±	±	–	–	–
Cucumber	+++	++	–	–	++	++	+++
Oriental melon	+	–	–	+	++	–	+
Tomato	+++	–	+++	+	+++	+	–
Cherry tomato	+++	–	+++	+	+++	+	–
Pumpkin	++	+	+++	–	–	+	+++

[a]–, ±, +, ++, +++ represents no, very little, little, moderate and strong pathogenic, respectively. Pathogenicity of each isolates was evaluated three days after inoculation of each isolate.
[b]OM-1, TO-1, HY-1, HY-5 and B-34 were isolated from harvested oriental melon, tomato, radish, potato and carrot, respectively.

Korea (Park, 1961; Song, 1997; Hyun, 2002). However, it has been known to have ability to infect several post-harvest plants, such as citrus fruit (Suprapta et al., 1995; Butler et al., 1988), peach (Crisosto et al., 2004; Wells, 1977), tomato (Oladiran et al., 1993), apple, pear, egg plant, carrot, cucumber, guava, melon, papaya, pumpkin, sponge gourd and turnip (Fatima et al., 2009; Saude et al., 2005) throughout whole countries.

This is first report of sour rot on vegetables like oriental melon, tomato, cherry tomato, cucumber, potato, pumpkin and carrot caused by *G. candidum*. *G. candidum* isolated had wide host range and strong pathogenicity against carrot, cucumber, tomato and pumpkin. The disease occurrence on several vegetables suggests that *G. candidum* can be a serious threat to stable production of fresh vegetable.

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