

日本国内で発生したNodulisporium melonisによるメロン根腐病(1)

発生,病徴,分離,病原性

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Root Rot of Melon Caused by *Nodulisporium melonis* in Japan*

1. Occurrence, Symptoms, Isolation and Pathogenicity

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Abstract

Collapse of melon with brown-rotted and corky roots occurred in Shizuoka Prefecture, Japan in 1975. This disease was named root rot of melon by Sato *et al.* in 1976. *Nodulisporium melonis* Watanabe & Sato (1995) was predominantly isolated from rotted root tissues together with five other fungus genera. In inoculation tests, *N. melonis* was pathogenic to melon seedlings, but other fungal isolates were not pathogenic. Melon and five other cucurbitaceous crops tested were diseased by growing in the artificially infested soil with *N. melonis*, but healthy in uninfested soils. This fungus was not pathogenic to wax gourd, and other 18 crops inoculated.

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Key words : melon, root rot, *Nodulisporium melonis*, pathogenicity.

INTRODUCTION

Melon (*Cucumis melo* L.) grown in vinyl houses wilted and finally collapsed in Asaba-chou, Shizuoka, Japan in May, 1975. Roots of diseased plants were rotted brown and characteristically corky (Fig. 2). The disease occurrence was also noticed in Toyoda-chou in July, and nearly whole plants near harvest were completely collapsed (Fig. 1). Although some roots of these collapsed plants were completely rotted, the others were often partially rotted and corky, and non-discoloration of vascular bundles observed (Fig. 3).

This root rot of melon, and the causal fungus, *Nodulisporium* sp. were first reported in Japan by Sato *et al.*²⁾, and later by Sato in 1976³⁾.

This is one of two papers⁹⁾ with the same title concerned with the disease occurrence of melon in Japan, symptoms, isolation and results of pathogenicity test in this report, together with our subsequent paper on the identification of the causal fungus.

MATERIALS AND METHODS

Isolations and fungi obtained. A total of 90 fungal isolates were obtained by single-hyphal tipplings from diseased root segments (5×5×4 mm) collected

from both Asaba-chou and Toyoda-chou, and plated on water agar at 25°C. The isolated fungi included 68 isolates of *Nodulisporium*, 14 of *Fusarium*, two each of *Rhizoctonia*, and *Alternaria*, and four unknown sterile fungi. All of *Nodulisporium* isolates were morphologically identical, and they are named *N. melonis* T. Watanabe and M. Sato⁹⁾.

Inoculation tests and test plants. In inoculation tests, melon seedlings were transplanted in the potted artificially-infested soil. The artificially-infested soils were prepared by mixing autoclaved soil with minced 12 day old potato dextrose broth cultures in 9 cm diam. petri dishes (one plate culture/800 g potted soil in 18 cm diam. clay pot) of the respective test fungi.

Inoculation tests were conducted using two representative *Nodulisporium* isolates (Isolates N-1 and N-8 obtained from Asaba-chou, and Toyoda-chou, respectively) and a total of 18 different crops. The crops tested include five cultivars of netted melon, oriental melon (*Cucumis melo* L.), water melon (*Citrullus lanatus* (Thunb.) Matsumura et Nakai), cucumber (*Cucumis sativus* L.), sponge gourd (*Luffa cylindrica* Roem.), wax gourd (*Benincasa hispida* Cogn.), pumpkin (*Cucurbita maxima* Duch.), two cultivars of tomato (*Lycopersicon esculentum* Mill.), eggplant (*Solanum melongena* L.), sweet pepper (*Capsicum annuum* L.), radish (*Raphanus sativus* L.), Chinese cabbage (*Brassica campestris* L.),

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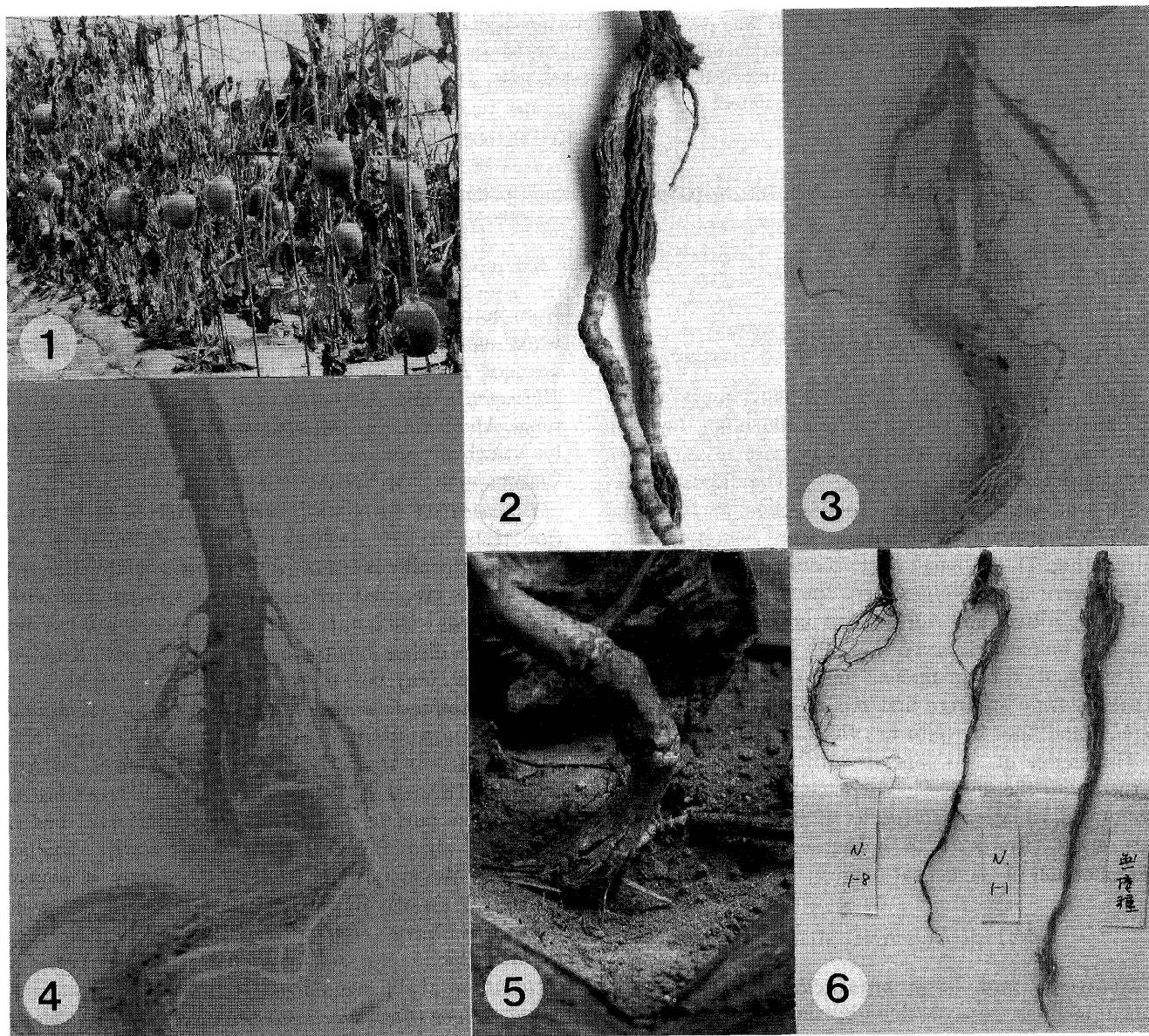
cabbage (*Brassica oleracea* L.), lettuce (*Lactuca sativa* L.), carrot (*Daucus carota* L.), spinach (*Spinacia oleracea* L.), strawberry (*Fragaria × ananassa* Duch.), and Welsh onion (*Allium fistulosum* L.). At least five plants each were inoculated in one experiment, and the experiment was repeated twice.

Results were obtained 50 days after inoculation, checking plant height, fresh root weight, and pathogenicity. Experiments were conducted under greenhouse conditions (soil temperature 10 cm below the soil surface, 17–24°C) in August to September 1975, and December 1975 to February 1976, simulating the routine cultural practices.

RESULTS

Symptoms

Retardation of growth was first noticed in Asaba-chou, Shizuoka, Japan in May of 1975, 15–30 days after transplanting in the vinyl houses, and their leaves became wilted with yellowish tint in the daytime, and normal in the evening. After repetition of day-time wilting and night-time recovery, the diseased plants gradually collapsed from basal leaves, resulting in final death. The almost whole basal stems and roots of collapsed plants were rotted brown, often with cracks near soil-surface (Figs. 4, 5), and if severely damaged, the



Root rot of melon caused by *Nodulisporium melonis*.

Fig. 1. Collapse of melon near harvest in one of vinyl houses at Toyoda-chou, Shizuoka, Japan.

Fig. 2. Damaged roots showing typical brown corky rot after disappearance of secondary roots and rootlets.

Fig. 3. Damaged stem and roots cut longitudinally showing undicolored vascular bundles.

Fig. 4, 5. Damaged basal stems (4,5) and roots (4) showing browning and cracks.

Fig. 6. Damaged roots (left two roots) grown in the artificially-infested soils with two isolates (N-1, N-8), and healthy roots (right) in uninfested soil.

roots were somewhat inflated, and corky with longitudinal cracks and ridges, and appeared taproot-like after complete disappearance of slender secondary roots, rootlets, and hairy roots (Fig. 2). Although some roots of these collapsed plants were completely rotted, the others

were often partially rotted and corky, and non-discoloration of vascular bundles observed (Fig. 3).

Inoculation tests

In preliminary inoculation tests onto melon seedlings, four representative *Nodulisporium* isolates were patho-

Table 1. Pathogenicity of two isolates (N-1, N-8) of *Nodulisporium melonis* onto 18 different crops grown in the artificially-infested soil^{a)}

Crops tested	Pathogenicity			Discoloration					
	Cont. ^{b)}	N-1	N-8	basal stems			roots(%) ^{c)}		
				Cont.	N-1	N-8	Cont.	N-1	N-8
Melon									
cv. Harukei no. 1	—	+	+	—	+	+	0a	95b	100c
cv. Natsukei no. 7	—	+	+	—	+	+	0a	98b	100b
cv. Vernet	—	+	+	—	+	+	0a	99b	100b
cv. Honeydew	—	+	+	—	—	+/-	0a	99b	98b
cv. Sunrise	—	+	+	—	+/-	+/-	0a	98b	100b
Oriental melon									
cv. New melon	—	+	+	—	—	—	0a	95b	97b
Cucumber									
cv. Chikanari-suyou	—	+	+	—	—	+/-	0a	82b	82b
Watermelon									
cv. Shinyamato 2	—	+	+	—	+/-	+/-	0a	98b	99b
Pumpkin									
cv. Tetsukabuto	—	nt ^{d)}	+	—	nt	+	0a	nt	32b
Wax gourd									
cv. Tougan	—	nt	+	—	nt	+	0a	nt	42b
Sponge gourd									
cv. Futohechima	—	—	—	—	—	—	0A	0A	0A
Tomato									
cv. Fukujyu no. 2	—	—	—	—	—	—	0A	0A	0A
cv. Toko K	—	—	—	—	—	—	0A	0A	0A
Eggplant									
cv. Senryo no. 2	—	—	—	—	—	—	0A	0A	0A
Sweet pepper									
cv. Suigyoku no. 2	—	—	—	—	—	—	0A	0A	0A
Radish									
cv. Tokinashi	—	—	—	—	—	—	0A	0A	0A
Chinese cabbage									
cv. Taibyō 60-nichi	—	—	—	—	—	—	0A	0A	0A
Cabbage									
cv. Hayadori	—	—	—	—	—	—	0A	0A	0A
Lettuce									
cv. Gureetoreeku	—	—	—	—	—	—	0A	0A	0A
Carrot									
cv. Kinkou 4-sun	—	—	—	—	—	—	0A	0A	0A
Spinach									
cv. King of Denmark	—	—	—	—	—	—	0A	0A	0A
Strawberry									
cv. Wanda-	—	—	—	—	—	—	0A	0A	0A
Welsh onion									
cv. Asagi 9-jyo	—	—	—	—	—	—	0A	0A	0A

a) Autoclaved potted soils were infested with PDA cultures of the respective fungi (one plate culture/18 cm clay pot). Inoculation tests were conducted using five plants each in one experiment in a green house (temperatures 10 cm below soil surface, 17–24°C), and the experiment was repeated twice. + : pathogenic or being discolored.

b) Plants grown in uninfested soil served as control.

c) Percentage of discolored area of roots assayed. Values with the same letter within a line do not differ significantly ($P = 0.01$ for small letters, $P = 0.05$ for large letters) according to the least significant difference test.

d) Not tested.

Table 2. Effect^{a)} of two isolates (N-1, N-8) of *Nodulisporium melonis* on the growth of six different crops in the artificially-infested soil in relation to that in uninfested soil served as control

Crops tested	Plant height (cm)			Fresh root weight (g)		
	Cont.	N-1	N-8	Cont.	N-1	N-8
Melon						
cv. Harukei no. 1	43.4a	25.6ab	23.2b	6.4a	3.8b	2.0c
cv. Natsukei no. 7	35.4a	34.6b	23.6b	4.8a	2.5b	2.1b
cv. Vernet	46.4A	27.4B	26.2B	7.1a	2.9b	1.9b
cv. Honeydew	57.0A	47.4A	42.6A	9.6a	2.0b	1.6b
cv. Sunrise	39.2A	50.6A	38.2A	6.7a	3.7b	2.7b
Oriental melon						
cv. New melon	53.0A	48.4A	40.6A	13.3a	4.4b	2.4b
Cucumber						
cv. Kinseisuyou	65.6A	51.8A	60.2A	28.4a	9.2b	10.6b
Watermelon						
cv. Shinyamato 2	104.4a	98.4a	80.0b	7.4a	2.6b	1.7b
Sponge gourd						
cv. Futohechima	150.3A	177.7A	155.0A	17.0A	23.2A	18.2A
Tomato						
cv. Fukuiju no. 2	31.8A	30.8A	31.8A	8.3a	7.5a	11.9b

a) Autoclaved potted soils were infested with PDA cultures of the respective fungi (one plate culture/18 cm clay pot). Inoculation tests were conducted using five plants each in a green house (temperatures 10 cm below soil surface, 17–24°C) in one experiment and the experiment was repeated twice. Values with the same letter within a line in two categories do not differ significantly ($P=0.01$ for small letters, $P=0.05$ for large letters) according to the least significant difference test.

genic to roots, causing brown discoloration within 15 days after inoculation, but none of four *Fusarium* isolates, and one isolate each of *Alternaria*, *Rhizoctonia* and unknown fungus were pathogenic. From diseased plants inoculated, the same *Nodulisporium* was reisolated.

In further inoculation tests, seven crops belonging to Cucurbitaceae were susceptible except sponge gourd, but other crops were not susceptible (Table 1). In 17 days after inoculation, roots became water-soaked and pale brown especially in secondary roots and rootlets initially, and whole roots were finally rotted brown (Fig. 6). Stout roots near soil surface were similarly water-soaked and pale brown initially, but gradually became corky and brown with longitudinal cracks, but aerial parts are rather healthy up to 40 days after inoculation. However, six inoculated cucurbitaceous crops were poorer in growth rate, and particularly in fresh root weight as compared with uninoculated plants served as controls, but sponge gourd and tomato were not influenced for their growth by inoculation (Table 2).

DISCUSSION

Since the first report of this disease in 1976, the disease has not been serious afterwards, because of efficient soil disinfection practices with chloropicrin (30 ml/m²) or methyl bromide (50 g/m²) in Shizuoka Prefecture before transplanting. However, this disease might have occurred sporadically and somewhere in Japan, and has been serious recently in Ibaraki Prefecture (T. Chiba, personal communication).

The similar wilt diseases with root rots and non-vascular discoloration at or near harvest have occurred

in Japan, including black dot disease caused by *Monosporascus cannonballus* Pollack & Uecker^{4–6,8)}, and root rot caused by *Pythium splendens* Braun⁷⁾. The gummy stem blight caused by *Mycosphaerella melonis* (Passerini) Chiu et Walker appears at first to be somewhat similar to this wilt disease especially in the basal stem symptom, but is readily differentiated by formation of pycnidia.

The roots of this disease were rotted brown and characteristically corky, but no vascular discoloration was observed (Fig. 3).

In inoculation tests, *Nodulisporium melonis* was proved to be the pathogen of this disease. Most of cucurbitaceous crops were susceptible to this fungus, but sponge gourd was not susceptible. Pumpkin and wax gourd were less susceptible than melon (Table 1). Inoculated melon plants were particularly less in root weight than uninoculated, but tops of both inoculated and uninoculated plants are not so much different. The root damage must be very influential for growth of fruit in the ripening stage, together with temperature rise from spring to summer, and increase of evaporation, resulting in wilt and final death. No disease of melon with brown-rotted and corky roots caused by *N. melonis* had been described before Sato *et al.*³⁾ in 1976, but the similar disease has occurred recently in Spain, and the causal fungus was reported as *Acremonium* sp. by García-Jiménez *et al.*¹⁾ in 1994. Although the symptoms of the diseases and the causal fungus in both Japan and Spain appear to be similar, the causal fungus in Japan was identified as *Nodulisporium* sp. at first in 1976^{2,3)}, but reidentified as *N. melonis* in our subsequent study⁹⁾.

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和 文 摘 要

佐藤允通・渡邊恒雄・古木市重郎・森田 儔：日本国内で発生した *Nodulisporium melonis* によるメロン根腐病 (1) 発生, 病徴, 分離, 病原性

1975年静岡県下のハウスメロンに根が褐変し、コルク化を伴う根腐病が発生した。この罹病植物の根部組織から分離された6属の糸状菌の中で、*Nodulisporium melonis* は優占種であった。接種試験により *N. melonis* はメロンに病原性を示したが、他の菌には全く病原性が認められなかった。*N. melonis* を接種した人為汚染土壌ではメロンとウリ科所属の5作物が発病したが、ヘチマや他の18供試作物は健全であった。