



UNIVERSITI PUTRA MALAYSIA

**DISEASE CAUSED BY PHYTIUM SPP. ON SELECTED CROPS
GROWN UNDER HYDROPONIC CULTURE SYSTEM AND THEIR
CONTROL**

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DISEASES CAUSED BY PYTHIUM SPP. ON SELECTED
CROPS GROWN UNDER HYDROPONIC CULTURE SYSTEM
AND THEIR CONTROL

BY

CHIN CHIEW LAN

A thesis submitted in partial fulfilment of the
requirements for the degree of Master of Agricultural Science
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ABSTRACT

An abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia in partial fulfilment of the requirements for the degree of Master of Agricultural Science.

DISEASES CAUSED BY PYTHIUM SPP. ON SELECTED CROPS GROWN UNDER HYDROPONIC CULTURE SYSTEM AND THEIR CONTROL

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1988

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Large scale hydroponic crop production is a recent entity in Malaysia with University of Agriculture Malaysia (UPM) playing a lead role in research and development. Since its inception in 1982, pre- and post-emergent damping-off in cucumber, muskmelon and tomato seedlings had been frequently observed. Pythium spp. were also isolated from roots of wilted mature cucumber, muskmelon and tomato plants at UPM hydroponic, at Malaysia Agricultural Research and Development Institute (MARDI) and at FIMA hydroponic in Fraser's Hill. The mature muskmelon plants exhibited drastic interveinal chlorosis and yellowing of young and old leaves at the onset of



fruiting and was accompanied by general necrosis of the root system resulting in subsequent plant death. Isolation of Pythium implicate them to be the causal agent. Since little is known about their role and control in the hydroponic system in Malaysia, studies were undertaken to characterize and identify the Pythium spp., to establish their pathogenicity, to determine the sources of inoculum, as well as to investigate the in-vitro and in-vivo efficacy of some fungicides in their control.

Through cultural and morphological studies, three Pythium spp. namely P. myriotylum, P. splendens and a non-sporulating Pythium sp. were identified from six isolates obtained.

P. myriotylum was isolated from muskmelon, cucumber and tomato grown in the hydroponic culture system in UPM, Serdang. P. myriotylum was characterized by its optimum temperature for growth at 35°C, and its ability to grow at 40°C and above. It produced numerous clavate, knob-like, or sickle-shaped appressoria. Inflated, digitate sporangia which discharged zoospores were observed in grass-blade water culture. It formed abundant oogonia with less than 10 diclinous antheridia in single cultures. Oospores were highly aplerotic with diameter ranging from 17.65 ± 0.72 to 21.15 ± 1.00 μm .

P. splendens was isolated from muskmelon in FIMA hydroponic set-up at Fraser's Hill. It produced numerous large spherical terminal hyphal swellings in culture which measured 40.4 ± 1.04 μm in diameter. It did not form oogonia nor oospore in single

cultures. The optimum and maximum temperature for growth was 30°C and 35°C respectively.

The unidentified Pythium isolated from tomato plant grown in the UPM hydroponic unit at Genting Highlands, produced slightly inflated, filamentous, dendroid hyphae which did not discharge zoospores. It neither formed hyphal swellings, appressoria nor any sexual reproductive structures. It grew optimumly at 30°C, and maximumly at 40°C. Protoplasmic streaming in young hyphae were observed.

The predominant Pythium sp. isolated in UPM hydroponic unit at Serdang, was P. myriotylum, and pathogenicity studies showed that it caused pre-emergent damping-off of cucumber, muskmelon and tomato; and post-emergent death of cucumber and muskmelon seedlings younger than 7 days after sowing (DAS). Cucumber and muskmelon plants older than 7 DAS appeared to be tolerant to P. myriotylum infection.

P. splendens isolated from the FIMA hydroponic set-up at Fraser's Hill and the unidentified Pythium sp. from UPM hydroponic unit at Genting Highlands, were pathogenic on all three crops namely cucumber, muskmelon and tomato at the pre-emergent stage.

All six isolates of Pythium viz P. myriotylum (4 isolates), P. splendens (1 isolate) and Pythium sp. (1 isolate) exhibited differential pathogenic response and isolates of the same species (P. myriotylum) varied in their pathogenic response. The pathogenicity studies further revealed that interveinal yellowing,



root death and subsequent plant mortality of mature muskmelon was not related to P. myriotylum infection. This was further confirmed by other University scientists who ascertained that the above symptoms were more the result of manganese and iron deficiency.

The inoculum source and population studies showed that P. myriotylum was present in the hydroponic nutrient solution and roots of both mature healthy as well as chlorotic muskmelon plant. In addition, the fluctuations in population level of Pythium were related to the phenology of the crop. P. myriotylum was also found to be present throughout the whole nutrient solution in the system.

In-vitro chemical efficacy studies indicated that the fungitoxicity varied according to Pythium sp. For P. myriotylum, etridiazole was the most toxic, and metalaxyl was the next most potent. Next in efficacy ranked propamocarb hydrochloride, oxadixyl plus mancozeb, copper hydroxide and phosetyl-Al in descending effectiveness. For P. splendens, on the other hand, metalaxyl was the most toxic; followed by etridiazole, oxadixyl plus mancozeb, copper hydroxide, propamocarb hydrochloride and phosetyl-Al in descending efficacy.

None of the four fungicides namely Copper hydroxide, metalaxyl, etridiazole and propamocarb hydrochloride outperformed each other significantly in the pre-emergent efficacy study. When applied into the nutrient solution as post-emergent treatment, metalaxyl was the most effective, followed by copper hydroxide, etridiazole and



oxadixyl plus mancozeb which did not differ significantly in the control of the disease. Phosetyl-Al and propamocarb hydrochloride showed negligible effect.



ABSTRAK

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi sebahagian daripada syarat-syarat untuk Ijazah Master Sains Pertanian.

PENYAKIT-PENYAKIT OLEH PYTHIUM SPP. PADA TANAMAN-TANAMAN TERPILIH DITANAM DI BAWAH SISTEM KULTUR HIDROPONIK DAN KAWALANNYA

Oleh

Chin Chiew Lan

1988

Penyelia : Prof. Madya Dr. Lim Tong Kwee
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Pengeluaran secara besar-besaran tanaman hidroponik adalah satu kewujudan baru di Malaysia dengan Universiti Pertanian Malaysia (UPM) memainkan peranan utama di dalam penyelidikan dan perkembangannya. Sejak bermulanya dari tahun 1982, penyakit melecur sebelum dan selepas cambah pada tanaman anak benih timun, tembikai wangi dan tomato didapati kerap berlaku. Pythium spp. telah juga dipencilkan dari akar-akar tanaman matang tembikai wangi, timun dan tomato yang layu di kawasan tanaman hidroponik, UPM, Institut Penyelidikan dan Kemajuan Pertanian Malaysia (MARDI) dan pada tanaman hidroponik FIMA di Fraser's Hill. Tembikai wangi matang



menunjukkan tanda-tanda klorosis di antara urat-urat daun yang amat ketara dan penguningan daun-daun muda dan tua pada peringkat permulaan membuah dan diikuti oleh nekrosis am sistem akar yang menyebabkan kematian tanaman. Pencilan Pythium mengaitkannya sebagai agen penyebab penyakit berkenaan. Oleh kerana hanya sedikit diketahui tentang peranan dan kawalannya di dalam sistem tanaman hidroponik di Malaysia, kajian-kajian telah dijalankan untuk perbandingan ciri-ciri dan pengenalan Pythium spp., menguji kepatogenan, menentukan punca-punca inokulum, di samping mengkaji keberkesanan beberapa racun kulat secara in-vitro dan in-vivo bagi kawalannya.

Melalui kajian-kajian kultur dan morfologi, tiga Pythium spp. iaitu P. myriotylum, P. splendens dan satu Pythium sp. yang tidak mengeluarkan spora, telah dicam daripada enam pencilan-pencilan yang didapati.

P. myriotylum telah dipencil daripada tembikai wangi, timun dan tomato yang ditanam di bawah sistem kultur hidroponik di UPM, Serdang. P. myriotylum telah dikenalpasti melalui ciri-ciri suhu optimum pada 35°C bagi pertumbuhannya dan keupayaan tumbuh pada 40°C ke atas. Ia mengeluarkan dengan banyak appressoria yang berbentuk klavat, seperti gembul atau sabit. Sporangium digitat yang membesar yang mengeluarkan zoospora didapati di dalam sistem kultur air bersama lai rumput. Oogonium telah didapati dengan banyak dan mempunyai kurang dari sepuluh anteridia diklinus dalam kultur

tunggal. Oospora adalah amat aplerotik dan mempunyai garis pusat berjulat antara 17.65 ± 0.72 hingga 21.15 ± 1.00 μm .

P. splendens telah dipencil daripada tembikai wangi pada Unit Hidroponik FIMA di Fraser's Hill. Ia mengeluarkan dengan banyak bengkakan hifa yang besar dan bulat di dalam kultur yang mempunyai garis pusat berukuran 40.4 ± 1.04 μm . Ia tidak membentuk oogonium atau oospora di dalam kultur tunggal. Suhu optimum untuk pertumbuhan ialah 30°C manakala suhu maksimum ialah 35°C .

Pythium yang tidak dapat dikenalpasti telah dipencil daripada tomato yang ditanam di Unit Hidroponik UPM di Genting Highlands, yang mengeluarkan hifa dendroid, berfilamen dan hanya membesar sedikit dan tidak mengeluarkan zoospora. Ia tidak membentuk bengkakan hifa, appressorium atau apa-apa struktur pembiakan seks. Ia mencapai pertumbuhan optimum pada 30°C , manakala pertumbuhan maksima pada 40°C . Aliran protoplasma di dalam hifa muda telah dilihat.

Pythium sp. utama yang telah dipencilkan di UPM, Serdang ialah P. myriotylum, dan ujian kepatogenan menunjukkan yang ia menyebabkan penyakit melecurh sebelum dan selepas cambah tanaman timun, tembikai wangi dan tomato; dan juga kematian selepas cambah anak benih timun dan tembikai wangi yang berusia muda iaitu tidak melebihi 7 hari selepas semaian. Tanaman timun dan tembikai wangi yang lebih tua daripada 7 hari selepas semaian didapati tahan terhadap jangkitan P. myriotylum.

P. splendens yang dipencil daripada Unit Hidroponik FIMA di Fraser's Hill dan Pythium sp. yang tidak dikenalpasti daripada Unit Hidroponik UPM, Genting Highlands didapati adalah merupakan patogen kepada ketiga-tiga jenis tanaman iaitu timun, tembikai wangi dan tomato pada peringkat sebelum cambah.

Kesemua 6 pencilan-pencilan Pythium iaitu P. myriotylum (4 pencilan), P. splendens (1 pencilan) dan Pythium sp. (1 pencilan) menunjukkan perbezaan respon kepatogenan dan pencilan yang sama daripada spesies (P. myriotylum) menunjukkan respon kepatogenan yang berlainan. Kajian kepatogenan juga menunjukkan bahawa kekuningan di antara urat-urat daun, kematian akar dan kematian pada tembikai wangi matang adalah tidak berkaitan dengan jangkitan P. myriotylum. Ini telah turut disahkan oleh lain-lain saintis universiti yang telah menunjukkan bahawa simptom-simptom di atas adalah lebih merupakan akibat kekurangan mangan dan besi.

Punca inokulum dan kajian populasi menunjukkan bahawa P. myriotylum terdapat di dalam larutan pemakanan hidroponik dan akar-akar kedua-dua tanaman tembikai wangi matang yang sihat dan juga yang menunjukkan simptom klorosis. Di samping itu, turun naik paras populasi Pythium didapati berhubung dengan fenologi tumbuhan tersebut. P. myriotylum telah juga didapati pada seluruh kandungan larutan pemakanan di dalam sistem berkenaan.

Kajian keberkesanan kimia in-vitro menunjukkan bahawa keracunan racun kulat adalah berlainan mengikut Pythium sp. Bagi P. myriotylum, etridiazole adalah paling beracun, diikuti berikutnya

