無土育苗介質檢出之 *Rhizoctonia solani* 的病原性與族群動態

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摘 要

由無土介質中誘釣 *Rhizoctonia*，可檢出 AG 4，AG 7，WAGO 與 AG 1，其中 AG 4 會造成典型病徵菜苗死亡，而 WAGO 與 AG 1 主要危害水稻，在甘藍苗上僅造成局部病斑，在蔬菜育苗介質中出現是因育苗業者習慣以田土或砂拌入無土介質中。WAGO 與 AG 1 較喜 30℃以上之高溫，而 AG 4 則在 25℃生長較快，因此選擇性培養基外，配合溫度處理也可作鑑別分離。*Rhizoctonia solani* 之寄主雖廣，但各融合群間之寄主範圍仍具差異性，AG 4，AG 1 與 WAGO 在直接與寄主體表接觸時會形成侵入褥 (infection cushion)，但隔著半透性之賽路芬 (cellophane) 置於甘藍苗上不會形成侵入褥，可能是與寄主接觸面過小，或賽路芬袋太厚以致對寄主植物體表無法辨認。每公斤泥炭土介質接種 1 克麥粒培養之 *Rhizoctonia* 接種源，於接種後第三天其族群量上升，以甘藍種子誘釣，檢出率高達 95% ，第六天則下降至 30 %，但在第 14 天其檢出率又高達 90 %，可能是於接種初期麥粒基質仍有足夠之營養基質 (food base)，而後因營養快速耗盡而下降；隨後族群再度上升，可能是由於無土介質所含之大量有機質適合 *Rhizoctonia* 之需求。而以 1 %米糠-BVB No. 4 介質培養之接種源，較適合 AG 4 group，其鑑別效率較高，但高量之米糠可能因含氮量太高，會導致細菌或其他拮抗菌大量增殖而抑制 *Rhizoctonia*，以致族群快速下降。由此可推論賽路芬 (*Rhizoctonia*) 之族群動態受基質中有機物質所左右，故以適當種類與含量之有機質管理可抑制 *Rhizoctonia* 造成之苗腐病。

關鍵詞：無土介質、立枯絲核菌、病原性、族群動態。

前 言

目前蔬菜栽培逐漸採用人工介質，尤其是育苗業，幾乎完全採用人工介質，而所需的介質及有機質肥料，除少部分爲國內生產製造外，大部分自國外進口，但都因價格昂貴，且品質不見得可靠，甚至含有多種病原菌[1, 2, 4, 5, 6, 8, 9, 11, 15]，其中以造成苗立枯病之 *Rhizoctonia* 與 *Pythium* 最常見 *Fusarium* 也曾發現，因此以介質育苗最迫切極待解決之問題是苗立枯病。各育苗場又常以田土，或其他植物殘體如木屑，拌入無土介質調製成實際使用之育苗介質，加以各場管理方式不同，因而實際發病狀況略有不同。本研究在於比較桃園場轄區之育苗場，造成苗立枯病之 *Rhizoctonia solani* 的分離株之融合群屬，其病原性差異，在不同基質(substrate)上之生長速率，與其在無土育苗介質中之族群動態。

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材料與方法

一、不同地區與蔬菜檢出之 *R. solani* 的融合群屬與生長形態

於大溪、芎林、竹東、苗栗之育苗場採芥菜，而後龍則採花椰菜之苗立枯病株，以水瓊脂(water agar)分別於 25、35℃利用種子誘釣法分離病原菌[3]，分離所得之 *Rhizoctonia* 以玻片對峙法(slide method)[13]鑑定其融合群，並以馬鈴薯瓊脂(PDA)培養基培養七天後，取直徑 0.5 cm 之菌絲塊，分別於 10、15、25、28,與 35℃之 PDA 上比較菌絲之生長速率。

二、AG 4 甘藍分離株 (Cab 4-11) 在不同基質之誘釣距離

AG 4 (Cab-11) *R. solani* AG 4 在不同基質以甘藍種子於不同距離誘釣。取 *R. solani* AG 4 之甘藍分離株 (Cab 4-11) ，以 PDA 培養基培養 7 天後，接種於 40-80 目之滅菌麥粒中，於室溫下培養七天後，再分別接種至 BVB No. 4 無土介質中 (2g/l) ，或沙中 (4g/l) ，15 天後以土片取樣器每處理取 30 片土片，分別嵌入 1 cm 厚，壓平之沙或 BVB No. 4 介質之表層，再分別在距土片 0.2、0.5、1、2、3 與 5 cm 處置甘藍種子進行誘釣 48 hrs，另取 15 片土片分別置於 PDA 與水瓊脂上檢測 *Rhizoctonia* 之菌絲生長速度。

三、不同之 *Rhizoctonia solani* 融合群對甘藍種苗之病原性差異

直徑 9 cm，底部舖 0.5 cm 厚之棉花，其上放置一層濾紙之玻璃培養皿，經高壓滅菌後，加 10 ml 無菌水，中央分別接種 *R. solani* 之 WAGO、AG 1、AG 4、AG 7 (陳隆鍾與莊再揚教授提供)等標準菌株，與 CAB 4-11、芎林、竹東、苗栗、後龍、大溪、中壢等分離株之 0.5 cm 菌絲塊，再分別置入 40 粒甘藍種子，於 25℃，16 hrs 光照之生長箱中培養，每處理 4 培養皿，4 重複，每 24 hrs 於培養皿各取 5 粒種子，記錄感染率外，並以 FAA (formalin acetic alcohol) 等體積比固定，以顯微鏡檢查 T-branch formation 以及菌絲群聚(mycelial aggregation)作爲侵入褥之形成指標[10]。另檢測不同分離株在甘藍種苗上形成侵入褥之能力，以 *R. solani* 之 WAGO、AG 1、AG 4 與 AG 7 (陳隆鍾教授提供) 之標準菌株以及 CAB 4-11、芎林、竹東、苗栗、後龍、大溪及中壢等分離株，以 PDA 培養基培養 7 天後，調整 Kousic 等人之方法[12] ，取菌落邊緣，以直徑 0.5 cm 之打孔器打成菌絲塊，分別置於賽路芬袋或聚乙烯膜(polyethylene membrane)之上後再置於甘藍之種子上，或直接置於濾紙上，以直接置於甘藍之種苗上者爲對照，每天以顯微鏡觀察侵入褥之形成。

四、*R. solani* AG 4 甘藍與西瓜分離株在 BVB No.4 與 Finnpeat 中之族群變化

R. solani AG 4 甘藍與西瓜分離株各一株，以 30-80 目之磨碎麥粒培養 7 天，每天搖動，使其分散不結塊，而後分別接種 1、2、3 g 之麥粒接種源至 1 ℓ 體積，含水量 60 %，以 60℃處理 3 小時後之 BVB No.4 與 Finnpeat 無土介質，不曾作熱處理者爲對照，再培養 7 天後，作爲接種源，培養期間仍每天劇烈搖動使接種源分散。而後分別於 1、3、5、7、15、30、60 天以直徑 0.8 cm 之吸管取樣，塞緊後切成 0.2 cm 之厚度，再置於單寧鑑別培養基上，每處理取 30 樣品，測 *R. solani* 之檢出率。另以誘釣法，把前述處理之介質，於 14 天後分別埋入甘藍種子誘釣，12 小時後取出種子以水洗淨，用無菌濾紙吸乾，置於單寧鑑別培養基上，測 *R. solani* 之檢出率。此外，再比較不同之 *R. solani* 分離株於添加米糠之 BVB No. 4 無土介質中之族群檢出率，以不同之 *R. solani* 分離株，於 PDA 培養基培養 7 天後，分別接種至含 0、1、10%米糠之 BVB No. 4 無土介質，在室溫下培養 7 天後，再各別以 1、2、4 %之比率接種至 BVB No. 4 無土介質，於 7 天後分別以初

秋甘藍之種子誘釣，比較 *R. solani* 分離株之檢出率。

結 果

由各育苗場分離之 *Rhizoctonia*，其融合群分屬於 WAGO、AG 1、AG 4 與 AG 7 (表 1) ，局部病斑之分離株多爲 WAGO，少部份爲 AG 1，典型縊縮病斑之分離株均爲 AG 4，各種病斑均可得到 AG 7，但比率不高。

表 1. 不同育苗場之蔬菜苗立枯株檢出之立枯絲核菌特性與融合群屬

Table 1. Colony characters and AG groups of *Rhizoctonia* isolated from diseased vegetable seedlings collected from various vegetable nursery centers.

Region	Vegetables	Number of isolates	Morphology on PDA	AG group
Taoyuen				
Dachi	mustard	2	White mycelium, embeded orange sclerotia.	WAGO
Chunli	mustard	2	White mycelium, embeded orange sclerotia.	WAGO
	cabbage	6	Brown, mycelium, flat colony, dark brown sclerotia.	AG 4
	cabbage	1	Brown, mycelium, flat colony, light brown to gray-whitish sclerotia.	AG 4
	cabbage	1	Brown and rare mycelium, large brown sclerotia with dark brown exudation.	AG 1
	Chinese cabbage	1	Brown, mycelium, flat colony, brown sclerotia.	AG 4
Hsinchu				
Chutung	mustard	2	White mycelium, embeded orange sclerotia.	WAGO
Chiunlin	mustard	2	White mycelium, embeded orange sclerotia.	WAGO
	mustard	1	Brown rare mycelium, large brown sclerotia with dark brown exudation.	AG 1
Miaoli				
Holung-1	mustard	2	White mycelium, embeded orange sclerotia.	WAGO
Holung-2	mustard	1	Light brown, cottony mycelium.	AG 7
Holung-3	cabbage	1	Brown rare mycelium, large brown sclerotia with dark brown exudation.	AG 1
Holung-4	cauliflower	4	Brown, mycelium, flat colony, brown sclerotia.	AG 4

R. solani 各分離株對不同溫度之適應性差異顯著 (表 2) ，WAGO (Mus-1, Chunli)於高溫生長快速，但 15℃以下時生長幾乎停滯。AG 1 (Holung-3)雖也略偏高溫，但不如 WAGO，而在 15℃以下則略可生長。AG 4 (Cab-11, Chunli)在 25℃生長快速，但不適高溫。AG 7 (Miaoli, Holung-2)在 25℃以上生長無顯著差異。

表 2. *R. solani* 各分離株於不同溫度，在 12 與 18 hr 時在 PDA 之生長長度
Table 2. Growth rate of various *Rhizoctonia* isolates at different temperatures on PDA (cm).

Isolate	AG group	Temperature (℃)									
		10		15		25		28		35	
		12hr	18hr	12hr	18hr	12hr	18hr	12hr	18hr	12hr	18hr
Mus-1	WAGO	—	—	—	0.1	0.3	0.8	0.7	1.2	0.5	1.3
Holung	AG 1	—	0.1	—	0.1	0.3	0.6	0.7	1.1	0.6	1.1
Cab11	AG 4	—	—	0.3	0.5	0.8	1.4	0.9	1.3	0.4	0.9
Holung	AG 7	—	—	0.2	0.5	0.6	1.1	0.7	1.2	0.4	1.0

WAGO (Mus-1, Chunli), AG 1 (Miaoli, Holung-3), AG 4 (Cab-11, Chunli), AG 7 (Miaoli, Holung-2).

R. solani AG 4 以甘藍種子誘釣之距離在 BVB No. 4 較遠，顯示基質之有機質含量較高則有助於其發展。而在 PDA 與水瓊脂表面上之生長速度無差異，但在 PDA 上菌絲較爲緻密 (表 3) 。

表 3. *Rhizoctonia solani* AG 4 在不同基質中，以甘藍種子誘釣之距離與在 agar 表面生長速度
Table 3. Baiting distance of *Rhizoctonia solani* AG 4 in different substrates and growth rate on agar surface.

Inoculum	Baiting distance (cm)		Mycelial growth distance (cm)	
	On surface of sand	On surface of BVB No. 4	On surface of PDA	On surface of water agar
Wheat-sand	0.2/0.5 z)	0.2/1	4.0 y)	3.8
Wheat-BVB No. 4	0.5/1	1/3	4.5	4.1

z) Baiting distance or length of mycelial growth after 24/48 hours.
y) Length differences of mycelial growth were insignificant on PDA and water agar, but mycelia were found dense on PDA and were rare on water agar.

WAGO 與 AG 1 會使甘藍胚軸患部略爲腫起，但僅造成局部病斑，不致造成植株死亡。AG 4 對甘藍具強病原性，患部快速縊縮，會造成植株死亡。而 AG 7 僅造成胚根輕度褐化 (表 4) 。WAGO 與 AG1 之菌絲會大量纏繞在甘藍之種皮上，且在胚軸上形成少量侵入褥，AG 7 雖有大量菌絲纏繞在甘藍之種皮上，但未能形成侵入褥。AG 4 之菌絲不但大量纏繞在甘藍之種皮上，且在甘藍之胚軸上形成大量侵入褥，最後造成典型病斑且苗死亡 (表 5) ，而隔著賽路芬半透膜，所有分離株均無法形成侵入褥，但 AG 4 若隔著賽路芬半透膜袋置於甘藍之胚軸上，在賽路芬袋內會形成褐色小點 (表 6) 。

表 4. 不同分離株與融合群屬之 *Rhizoctonia solani* 對初秋甘藍苗之病原性差異與病徵

Table 4. Pathogenicity of different isolates of *Rhizoctonia solani* AG groups to cabbage seedlings (K-Y cross, Taki).

Isolates	Source	AG group	Apperance	Rate of lesion[z] (%)
WAGO	From Prof. Chen	WAGO	No symptom at first 3 days, seed coat lesion appear at 4th day, but no further development until 6th day.	14
AG1	From Prof. Chen	AG 1	No symptom at first 2 days, seed coat lesion appear at 3rd day, but no further development until 6th day.	18
26-1	From Prof. Chuan	AG 4	Seed coat lesion appear at 2nd day, hypocotyl lesion appear at 5th day.	42
Mo1550	From Prof. Chuan	AG 7	Mycelial mass on seed coat, but no obvious symptom were found.	0
Cab4-11	cabbage	AG 4	Seed coat lesion appear at 2nd day, hypocotyl lesion appear at 5th day.	56
Dachi	Mustard	WAGO	No symptom at first 3 days, seed coat lesion appear at 4th day, but no further development until 6th day.	18
Chunli	mmustard	WAGO	No symptom at first 3 days, seed coat lesion appear at 4th day, but no further development until 6th day.	12
	cabbage	AG 4	Seed coat lesion appear at 2nd day, hypocotyl lesion appear at 5th day.	48
	Chinese cabbage	AG 4	Seed coat lesion appear at 2nd day, hypocotyl lesion appear at 5th day.	52
Chutung	mustard	WAGO	No symptom at first 3 days, seed coat lesion appear at 4th day, but no further development until 6th day.	22
Chiunlin	mustard	WAGO	No symptom at first 3 days, seed coat lesion appear at 4th day, but no further development until the day.	18
Miaoli	mustard	WAGO	No symptom at first 3 days, seed coat lesion appear at 4th day, but no further development until 6th day.	16
	mustard	AG 7	Mycelial mass coil on seed coat, but no symptom were found on hypocotyls.	0
Holung	cauliflower	AG 4	Seed coat lesion appear at 2nd day, hypocotyl lesion appear at 5th day.	56

z) Lesions were calculate at 6th day.

表 5. 不同分離株之 *Rhizoctonia solani* 在初秋甘藍苗上形成侵入褥之能力與造成之病徵。

Table 5. Rate of damping-off, and infection cushion formation by various *Rhizoctonia solani* isolates on cabbage (K-Y cross, Taki) seedlings.

Isolates	Source	AG group	Disease incidence[z)] (%)	Infection cushion[y)]	Symptom
WAGO	From Prof. L. C. Chen	WAGO	16 (brownization of root surface)	+	Local lesion on hypocotyl.
AG 1	From Prof. L. C. Chen	AG 1	14	+	Local lesion on hypocotyl.
26-1	From Prof. T. Y. Chuan	AG 4	80 (typical damping-off)	+++	Typical damping-off, and death of seedlings.
AG 7	From Prof. L. C. Chen	AG 7	0	−	Slight brownization of root.
Cab4-11	cabbage	AG 4	100 (typical damping-off)	+++	Typical damping-off, and death of seedlings.
Dachi	mustard	WAGO	20	+	Local lesion on hypocotyl
Chunli	mustard	WAGO	8	+	Local lesion on hypocotyl
	cabbage	AG 4	100	+++	Typical damping-off, and death of seedlings.
	Chinese cabbage	AG 4	100	+++	Typical damping-off, and death of seedlings.
Chutung	mustard	WAGO	10	+	Local lesion on hypocotyl
Chiunlin	mustard	WAGO	20	+	Local lesion on hypocotyl
Miaoli	mustard	WAGO	16	+	Local lesion on hypocotyl
	mustard	AG 7	0	−	Slight brownization of root.
Holung	cauliflower	AG 4	90	+++	Typical damping-off, and death of seedlings.

z) Infection were calculate at the 14th day.

y) Calculation of number of T-branch formation.

表 6. 不同分離株之 *Rhizoctonia solani* 於賽路芬袋內或聚乙烯膜上置於初秋甘藍苗上形成侵入褥之能力

Table 6. Formation of infection cushions by various *Rhizoctonia solani* isolates in cellophane bags, on polyethylene membrane over cabbage seeds respectively, on filter papers or directly on cabbage seeds.

Isolates	AG group	Mycelium disk directly on seeds	Mycelium disk in cellophane bag and put over seeds	Mycelium disk on filter paper	Mycelium disk on polyethylene membrane and put on over seeds
Mustard	WAGO	−	−	−	−
Mustard	AG 1	+	−	−	−
Mustard	AG 7	−	−	−	−
Cauliflower	AG4	+++	−	−	−
Cab4-11	AG4	+++	−, brown spot in cellophane bag	−	−
Dachi	WAGO	+	−	−	−
Chunli	WAGO	+	−	−	−
Chutung	WAGO	+	−	−	−
Chiunlin	WAGO	+	−	−	−
Miaoli	WAGO	+++	−	−	−
Holung	AG4	+++	−, brown spot in cellophane bag	−	−

未作熱處理之 BVB No.4 與 Finnpeat 兩種無土介質，於接種 *R. solani* 之麥粒接種源，3 天後之檢出率即達 80 %以上，超出繁殖體之合理估算範圍，而預作 60℃處理之無土介質，R. solani，之檢出率在 50-60 %之間 (表 7) ，估計之之繁殖體數已超過 5 propagule/g ，而 4-6 天時雖呈下降 (表 8，9) ，但十四天後又再超出合理之估算範圍。以米糠-BVB No. 4 介質培養之接種源，由分離之效率顯示較適合 AG 4 group，尤以米糠含量 1% 之接種源，其鑑別效率較高，甚至不含米糠，僅以 BVB No. 4 培養之接種源也適合 AG 4 群之增殖。但米糠之含量達 10 %之接種源，可能因含氮量太高，致使細菌，或其他拮抗菌大量繁殖，可能反過來抑制 *Rhizoctonia*。

表 7. 無土介質 BVB No.4 與 Finnpeat 接種麥粒培養 3 天後之 *Rhizoctonia solani* 的檢出率

Table 7. Baiting frequency of *Rhizoctonia* isolates from soilless mixture for three days after inoculations of wheat inoculum.

Brands of soilless mixture	Treatment	Amount of inoculum (g/l)							
		0	1	2	3	0	1	2	3
		Cabbage isolate (%)				Water melon isolate (%)			
BVB No.4	Unheated	0	90	100	95	0	80	95	100
	60 ℃	0	60	60	60	0	60	60	60
Finnpeat	Unheated	0	80	95	96	0	75	85	95
	60 ℃	0	60	65	80	0	50	65	55

表 8. BVB No.4 與 Finnpeat 接種麥粒培養 6 天後之 *R. solani* 的檢出率

Table 8. Baiting frequency of *Rhizoctonia* isolates from soilless mixture for six days after inoculations of wheat inoculum.

Brands of soilless mixture	Treatment	Amount of inoculum (g/l)							
		0	1	2	3	0	1	2	3
		Cabbage isolate (%)				Water melon isolate (%)			
BVB No.4	Unheated	0	40	50	90	0	45	60	100
	60 ℃	0	30	85	100	0	60	100	100
Finnpeat	Unheated	0	40	75	80	0	35	55	85
	60 ℃	0	45	90	85	0	45	85	95

表 9. BVB No.4 與 Finnpeat 接種麥粒培養 14 天後之 *R. solani* 於甘藍種子之誘釣率

Table 9. Baiting frequency of *Rhizoctonia* isolates from soilless mixture for fourteen days after inoculations of wheat inoculum.

Brands of soilless mixture	Treatment	Amount of inoculum (g/l)							
		0	1	2	3	0	1	2	3
		Cabbage isolate (%)				Water melon isolate (%)			
BVB No.4	Unheated	0	95	95	ND	0	100	100	ND
	60 ℃	0	100	60	ND	0	100	100	ND
Finnpeat	Unheated	0	95	95	ND	0	100	100	ND
	60 ℃	0	60	100	ND	0	100	100	ND

ND: Not determined.

表 10. 不同 *R. solani* 分離株之不同比率米糠接種源於 BVB No. 4 以甘藍種子之誘釣率

Table 10. Baiting frequency of various *Rhizoctonia solani* isolates from BVB No. 4 soilless nursing medium inoculated with various percent of rice bran inoculum.

Isolates	AG group	% of rice bran in substrates of inoculum								
		0			1			10		
		Amount of inoculum inoculated (%)								
		4	2	1	4	2	1	4	2	1
Chen	WAGO	28	8	5	22	18	12	90	85	23
26-1	AG4	40	38	18	78	48	48	100	86	42
Cab 4-11	AG4	57	35	21	85	40	25	100	10	56
Chunli	WAGO	12	6	0	26	16	6	95	78	32
Chiunlin	WAGO	8	6	2	48	27	8	95	76	55
Miaoli	WAGO	14	8	5	16	22	6	86	84	46
Holung	AG4	2	1	1	65	52	8	100	100	58

討 論

先前以蔬菜種子在無土介質中誘釣 *Rhizoctonia*，僅檢出 AG 4、AG 7 與 AG 8 [4]，而實際自業者之病株中卻可檢出 WAGO 與 AG 1，可能是育苗業者習慣以田土，或砂拌入無土介質中以改善通氣性與增加重量。事實上 WAGO 與 AG 1 之主要寄主爲水稻[16]，主要存在於稻田土壤中，於甘藍苗僅造成 local lesion。由於 WAGO 與 AG 1 較喜 30℃以上之高溫，而 AG 4 則在 25℃生長較快，因此選擇性培養基外，配合溫度處理也可作鑑別分離(differential isolation)。

R. solani 之寄主雖廣，但各融合群間之寄主範圍仍具差異性[14]。侵入褥之形成能力常用於評估其病原性[12]，*R. solani* 隔著半透性之硝化纖維素膜(celloidin)置於感病之大豆葉表仍會形成侵入褥[12]，本實驗顯示 *R. solani* 僅在直接接觸寄主體表時形成侵入褥，而在具半透性之賽路芬袋內，雖與寄主體表接觸，仍未形成侵入褥，而與 Kousic, et al, [12] 之結果有異，是否爲接觸面過小，或賽路芬袋太厚以致對寄主植物體表無法辨認 (recognition) 則尚待研究。

麥粒培養之 *Rhizoctonia*，於接種後第 3 天以土片法檢測其族群量呈上升，但第 6 天則接種 1 g/l 甘藍分離株之處理，其族群量有下降之趨勢，但在第 14 天以甘藍種子誘釣，其檢出率卻又高達 90 %，可能是於接種初期仍依賴麥粒培養基提供之營養，而後族群量因營養基質(food base)耗盡而下降，而後族群再度上升可能是由於無土介質含大量之有機質，尤其是纖維素因適合 *Rhizoctonia* 之需求所致[7]。而以米糠 BVB No. 4 介質培養之接種源，由分離之效率顯示較適合 AG 4 group，尤以米糠含量 1 % 之處理其鑑別效率較高，但過高之米糠可能因含氮量太高，致使細菌，或其他拮抗菌大量繁殖而抑制了 *Rhizoctonia*。由實驗之結果顯示，*Rhizoctonia* 之族群動態受基質中之有機物質所左右，因此，可推論介質以適當種類與量之有機質管理可抑制 *Rhizoctonia* 造成之苗腐病。

參考文獻

1. 吳文希。1985。第十二章侵入前之活動。植物病理學 p.197-209。茂昌圖書公司 405pp.。
2. 吳文希。1988。立枯絲核菌之性質及防治植物土媒病原學 (第一部份 玖：病害種類 p.61-67)。國立編譯館 259pp.。
3. 黃振文、楊尚勳。1992。芥蘭苗床立枯絲核菌的偵測技術。植保會刊 1: 26~30(英文發表)。
4. 葉俊巖。1995。底部間歇式灌溉法對苗立枯病管理之研究報告。農林廳八十四年度計畫評議會報告：桃 2-1。
5. Agrios, G. N. 1988. Root and stem rot caused by *Basidiomycetes* p.280-495. Part II specific plant disease, 11 plant disease caused by fungi, in Plant Pathology 3rd. ed. 803pp.
6. Cartwright, D. K., H. W. Sparr, and H. D. Shew. 1995. Commercial potting medium as the source of *Pythium* causing a disease on tobacco transplant. Plant Dis. 79: 538 (abstr.).
7. Chung, Y. R., H. A.. J. Hoitink, W. A. Dick, and L. J. Herring. 1988. Effects of organic matter decomposition level and cellulose amendment on the inoculum potential of *Rhizoctonia solani* in hardwood bark media. Phytopathology 78: 836-840.
8. Couteaudier, Y. C. Alabouvette, and M. L. Soulas. 1985. Necrose du collet et pourritare des racines de tomate. Rev. Hortic. 254: 39-42 (English abstract).
9. Favrin, R. J., J. E. Rahe, and B. Mauza. 1988. *Pythium* associated with with crown rot of cucumber in

British Columbia green house. Plant Dis. 72: 683-687.

10.Keijer, J. 1996. III. 1. The initial steps of the infection process in *Rhizoctonia solani*. p.149-162 In "*Rhizoctonia* species : Taxonomy, molecular biology, Ecology, Pathology and disease control" 578pp. Sneh, B., Jabaji-Hare, S., Neate S. and Dijst, G. eds. Kluwer Academic Publishers. The Nethrlands.

11.Kim, S. H., L. B. Forer, and J. L. Longenecker, 1975. Recovery of plant pathogens from commercial peat-products. Proc. Am. Phytopathol. Soc. 2: 124 (abstr.).

12.Kousic, C. S., J. P. Snow, and G. T. Berggren. 1994. Factors affecting infection cushion development by *Rhizoctonia solani* AG 1. IA and IB on soybean leaves. Plant pathology 43: 237-244.

13.Kronald, W. C., and M. E. Stanghellini. 1988. Clean slide technique for the observation of anastomosis and nuclear condition of *Rhizoctonia solani*. Phytopathology 78: 820-822

14.Ogoshi, A. 1987. Ecology and pathogenicity of anastomosis and intraspecific groups of *Rhizoctonia solani* Kühn. Annu. Rev. Phytopathol. 25: 125-154.

15.Robertson, G. I. 1973. Occurence of *Pythium* spp. in New Zealand soils, sands, pumices, and peat , and on roots of container-grown plants. N. Z. L. Agric. Res. 16: 357-365.

16.Sneh, B., L. Burpee, and A. Ogoshi. 1991. VII. Anastomosis groups of multinucleate *Rhizoctonia* spp. In "Identification of *Rhizoctonia* species" 133pp. Sneh B. eds. APS Press, St. Paul, Minnesota.

Pathogenicity and Population Dynamics of *Rhizoctonia solani* Isolated from Soilless Nursing Mixture

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Summary

AG 4, AG 7, WAGO and AG 1 anastomosis groups of *Rhizoctonia solani* were isolated from diseased seedlings collected from soilless nursing mixtures prepared with sand or rice field soil. Typical symptoms and death of vegetable seedlings only caused by AG 4 groups. Whereas local lesions were caused by WAGO and AG 1 groups. Growth of WAGO and AG 1 were faster at 30℃ or higher, however, AG 4 groups favor 25℃ for mycelial growth, thus temperature treatments associated with selective media may available for differential isolation of *R. solani*. Host ranges of *R. solani* are very wide, yet differences were among different anastomosis groups. Any groups of *R. solani* didn't form infection cushions in cellophane bags, even directly put the bags on cabbage seedlings, perhaps due to insufficient area of contact or missed recognition of host surface structure due to the thickness of cellophane bags, but AG 4, AG 1 and WAGO did form infection cushions only when directly contact with host tissues. Populations of *Rhizoctonia* in soilless nursing mixture were arised after three days of wheat inoculum were inoculated, but tends to decreased after six days of inoculation, however, baiting frequencies of the pathogen were again higher than 90 %, perhaps due to consumption of primary food base, the rebound of *Rhizoctonia* population were postulated as colonization of the fungus on organic materials in soilless nursing mixture. 1 % of rice bran-BVB No. 4 were more available for prepare of inoculum for AG 4 group, but higher rice bran contant would result in over proliferation of bacteria or certain antagonists since its higher content of nitrogen sources. Thus it was postulated, proper strategies for organic matter management for soilless nursing mixture may be available approach for managing *Rhizoctonia* damping-off .

Key words: Soilless mixture, *Rhizoctonia*, Pathogenicity, Population dynamics.

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