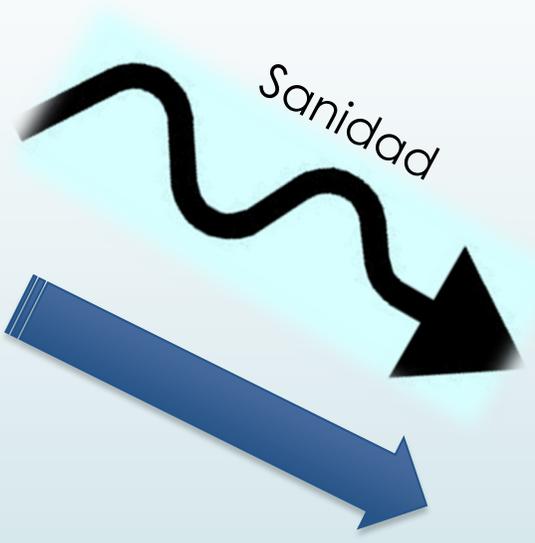




ENFERMEDADES DEL ALGODONERO CON ORIGEN EN EL SUELO Y SU CONTROL CON *Trichoderma*

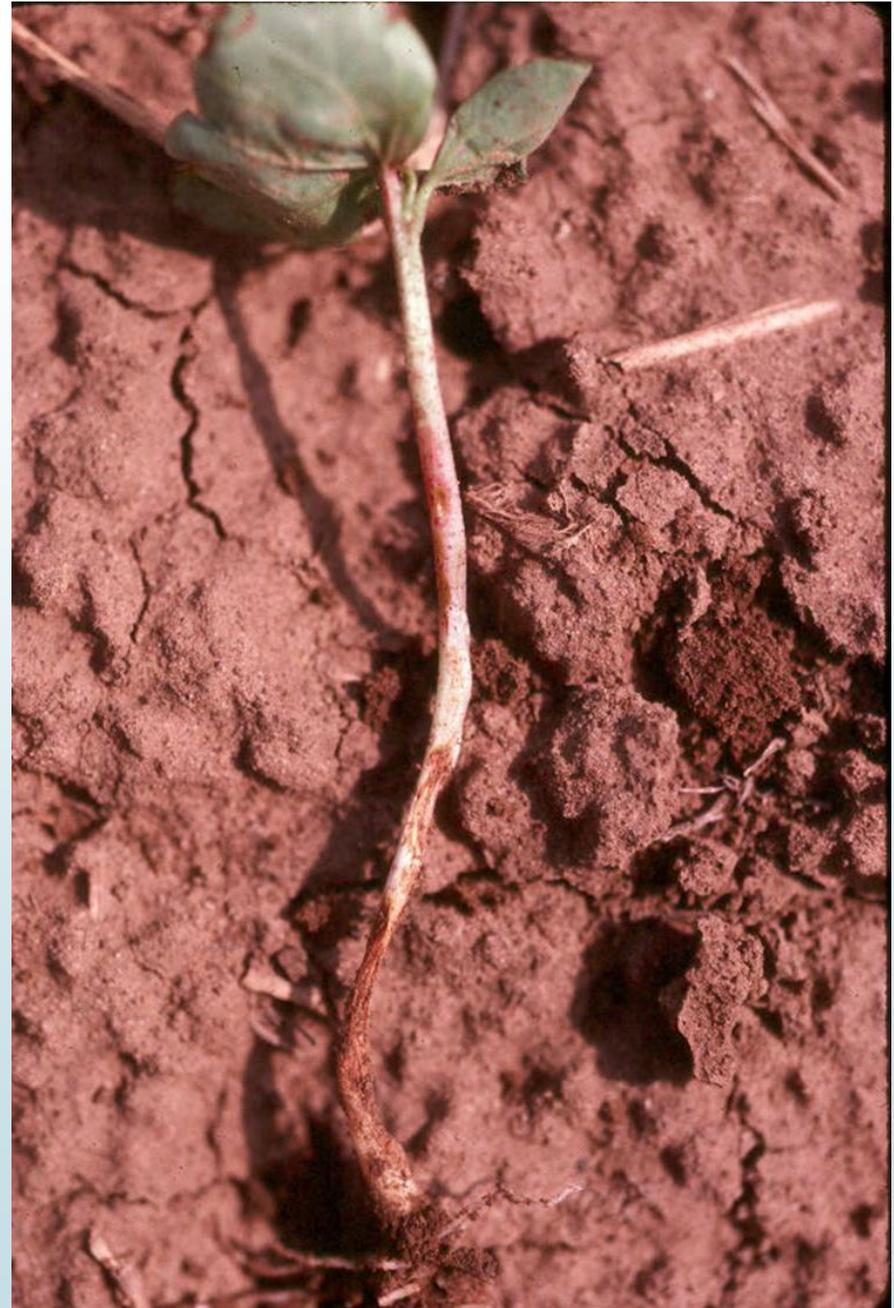


Dr. César Guigón López



Enfermedades de plántulas





Marchitamiento por *Fusarium*





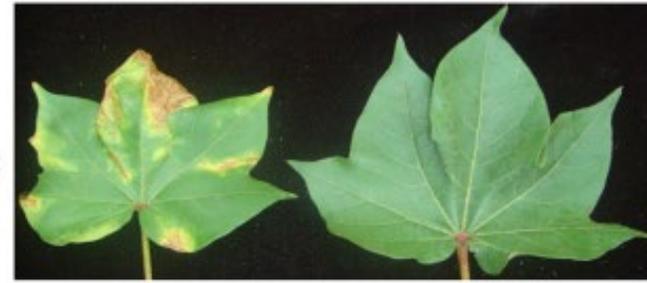


UGA1234229

Marchitamiento por *Verticillium*

A

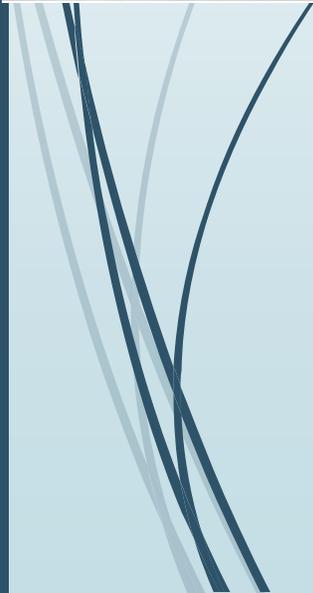
Leaf from infected plant



Leaf from non-infected plant







Pudrición texana



Phymatotrichopsis omnivora (Duggar) Hennebert
(=*Phymatotrichum omnivorum* Duggar)



Manejo Integrado

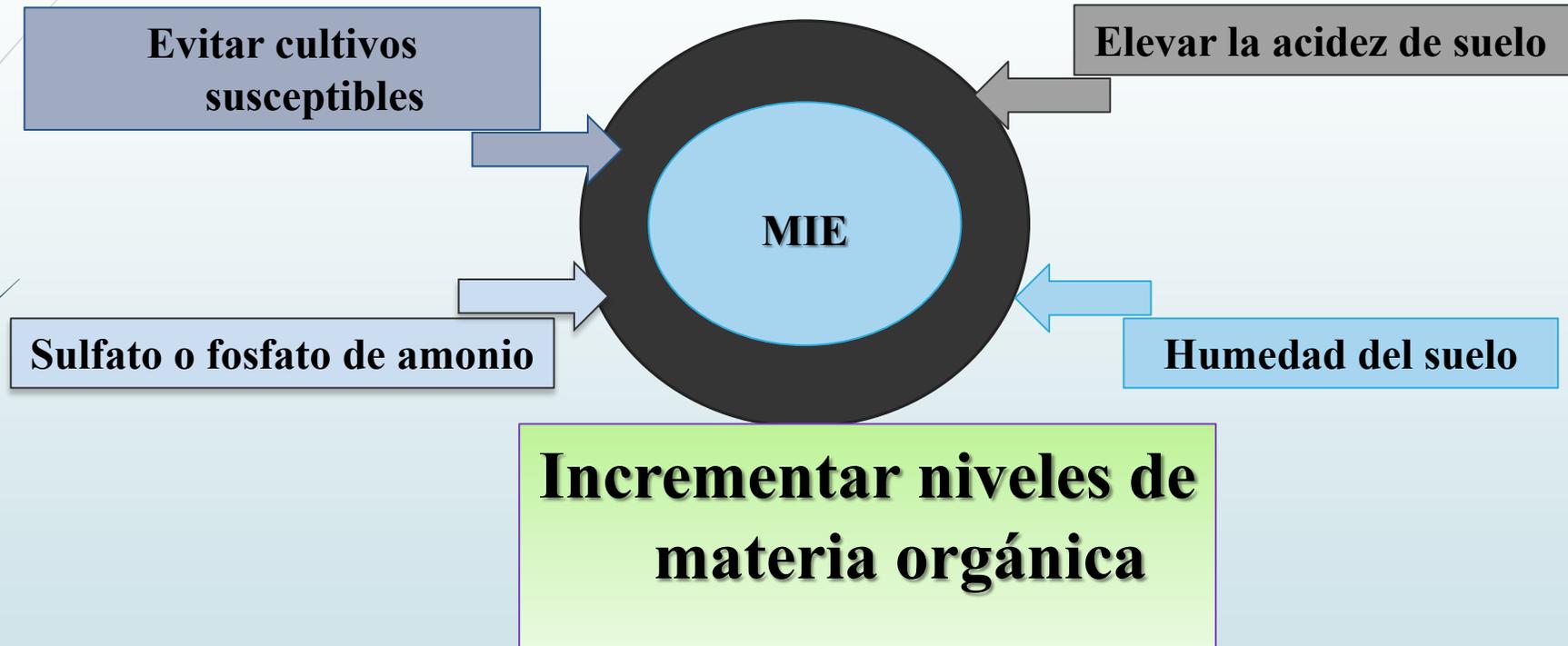


Medidas generales de control de enfermedades en algodón

- Sembrar variedades resistentes.
- Semilla de buena calidad.
- Siembra en camas altas e incrementar el drenaje.
- Siembra cuando temperatura del suelo (10 cm de profundidad) a las 8 am sea de 15.5 °C (60 °F) y cuando se pronostiquen 5 días de clima cálido.
- Siembra en suelo fértil.
- En siembras tempranas en suelos arcillosos y de mal drenaje, tratamiento con fungicida en surco.
- Rotación con trigo, soya o maíz.

MANEJO INTEGRADO

(Lyda, 1978; Percy, 1983; Samaniego-Gaxiola *et al.*, 2003).



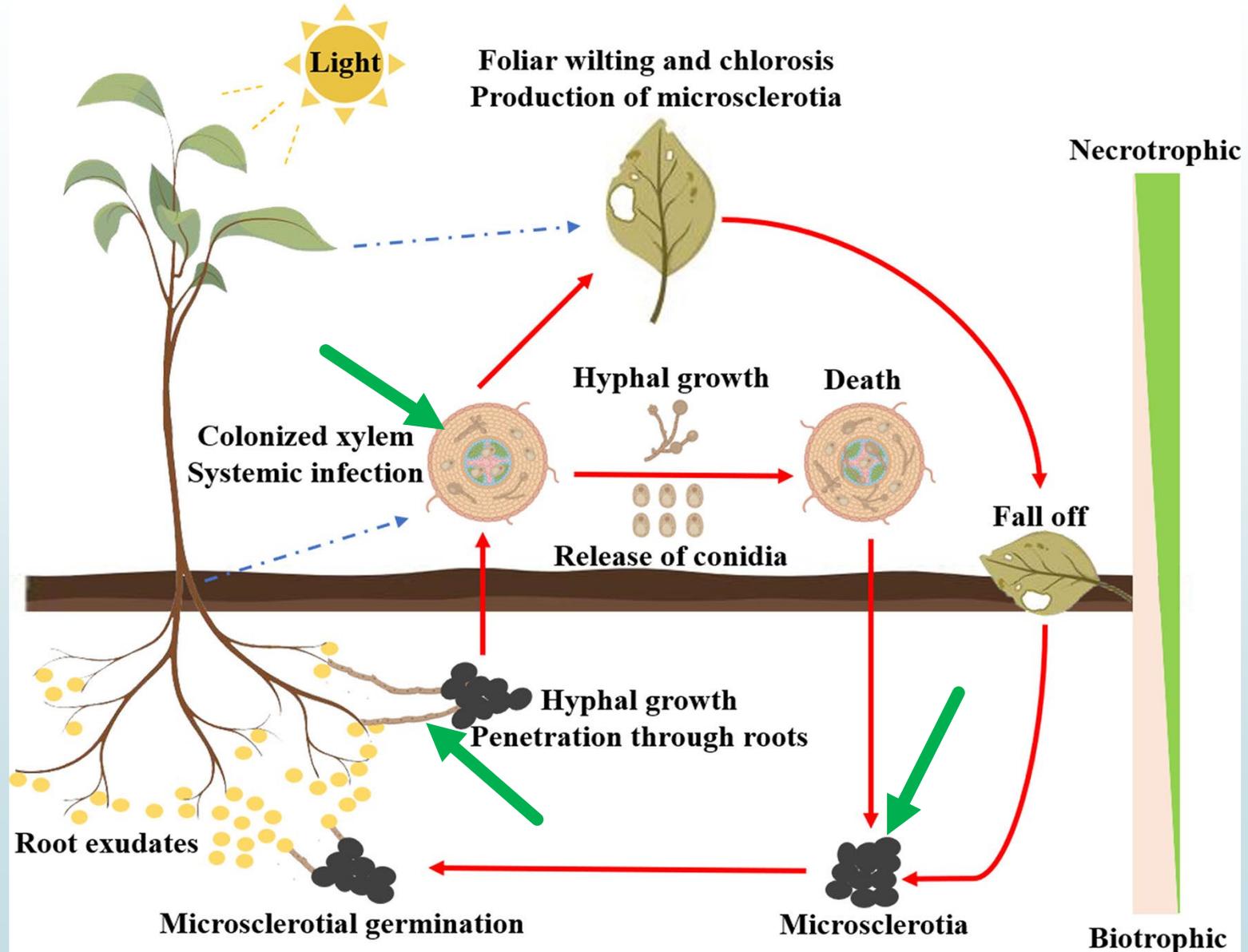


Control biológico

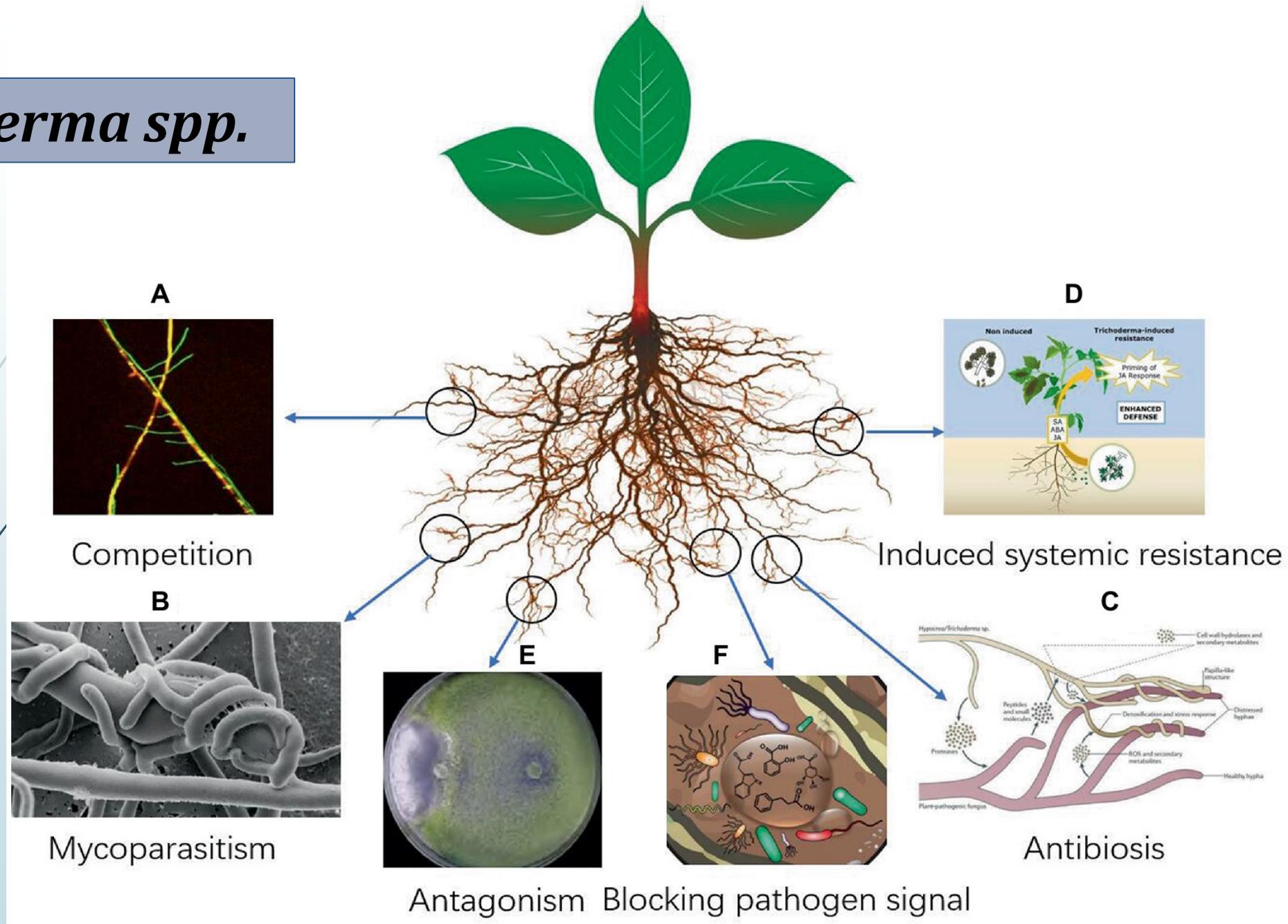
- ✓ Actinomicetos
- ✓ Bacterias
- ✓ Hongos

97 hongos (Samaniego y Herrera, 1989)

Importancia del ciclo de la enfermedad



Trichoderma spp.





Caracterización

Identificación

Morfológica

En PDA

Molecular

DNA

Antagonismo

Crecimiento y actividad metabólica

En Placa

Microcalorimetría

Fisiología y Bioquímica

Antagonismo

P. micelio

P. esclerocios

Antibiosis

Perfil enzimático

Cinética

Sustratos

Génica

RT-PCR

Inducción

Confrontación

QPCR

Cinética

Selección

**Cepas de clima caliente
WWS**



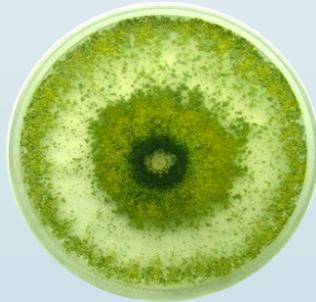
T341



T479



T359



T397

**Cepas de clima templado
TWS**



TC74



TC74m



Th1



Th2

Cepa	Morfología	Molecular	Homología
TC74	<i>T. harzianum</i>	<i>T. asperellum</i>	99-100 %
Th1	<i>T. harzianum</i>	<i>T. asperellum</i>	100 %
Th2	<i>T. harzianum</i>	<i>T. asperellum</i>	100 %
T359	<i>T. viride</i>	<i>T. asperellum</i>	100 %
T397	<i>Trichoderma sp.</i>	<i>T. longibraquiatum</i>	100 %
T341	<i>T. harzianum</i>	<i>T. asperellum</i>	100 %
T479	<i>T. viride</i>	<i>T. asperellum</i>	100 %
TC74M	<i>T. harzianum</i>	<i>T. asperellum</i>	100 %

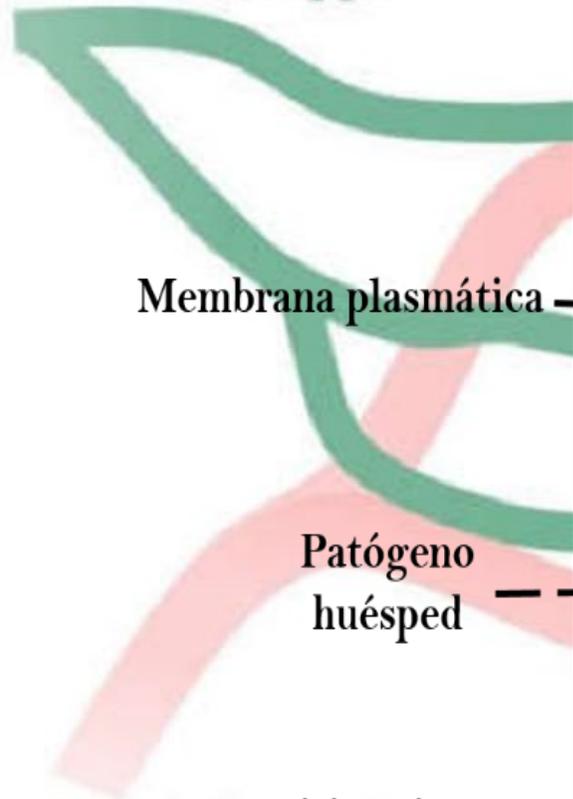
Antagonismo

Confrontaciones *in vitro*

- **Potencial de biocontrol de cepas**
- **Detección de antibióticos y enzimas**
- **Variaciones en el potencial antagónico**



Trichoderma spp.



Membrana plasmática

Patógeno huésped

Quitina sintasa
Fitopatógeno
B-glucano sintasa

Pared celular

Cell-wall

Plasma membrane

Host fungus

Chitin synthase
 -β-glucan synthase

Quitinasa

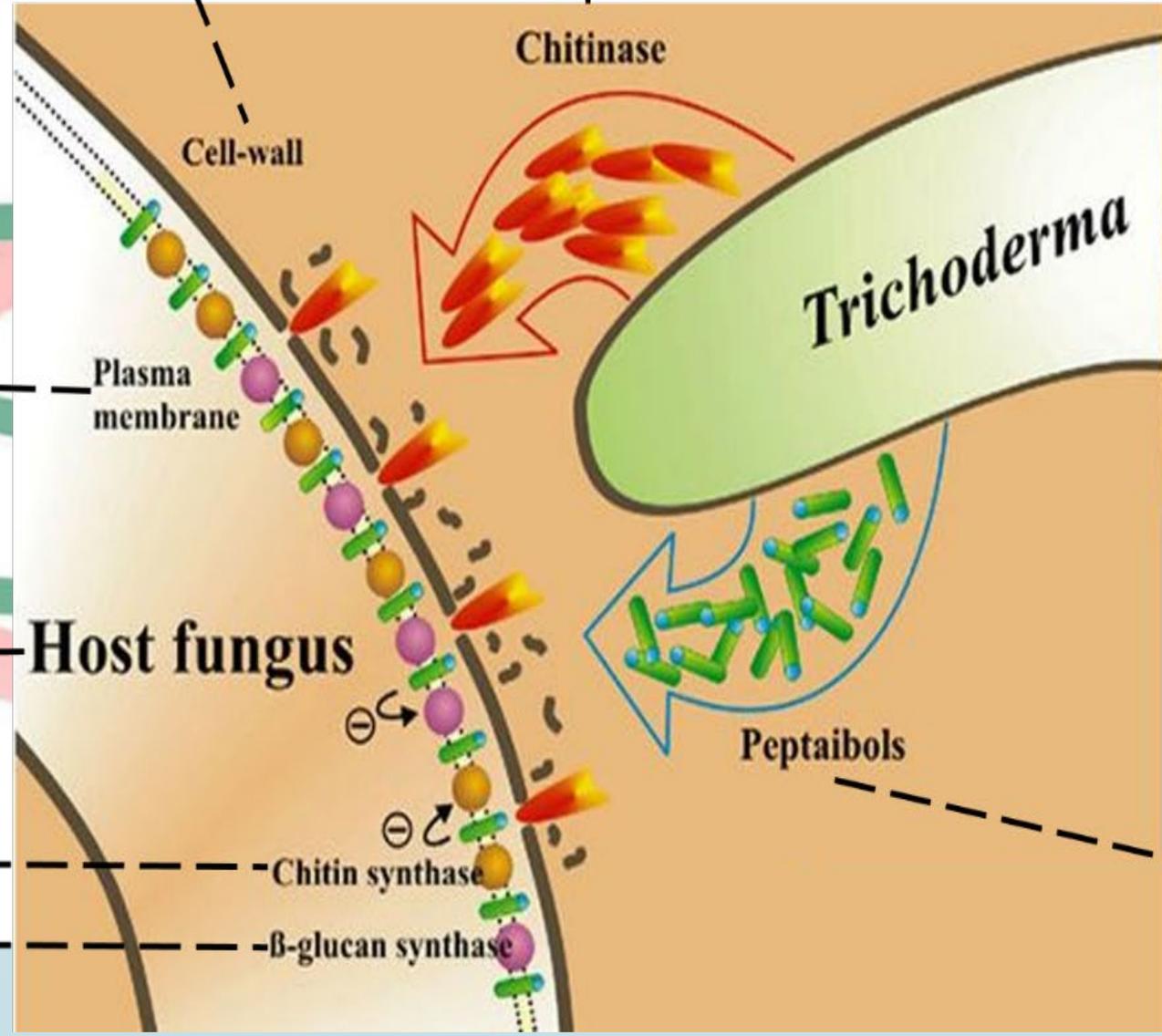
Chitinase

Trichoderma

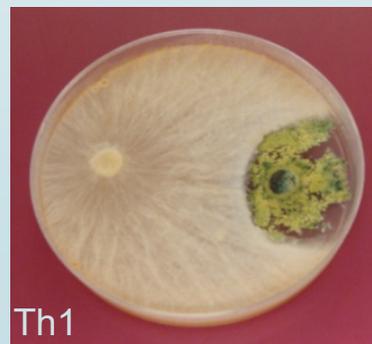
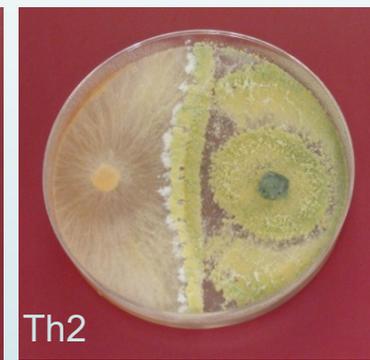
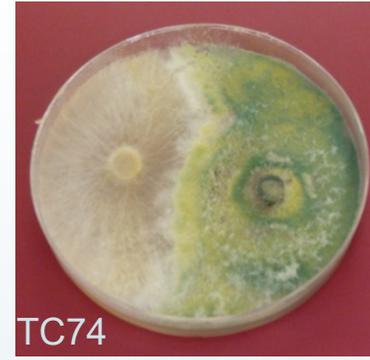
Peptaibols

Peptaiboles

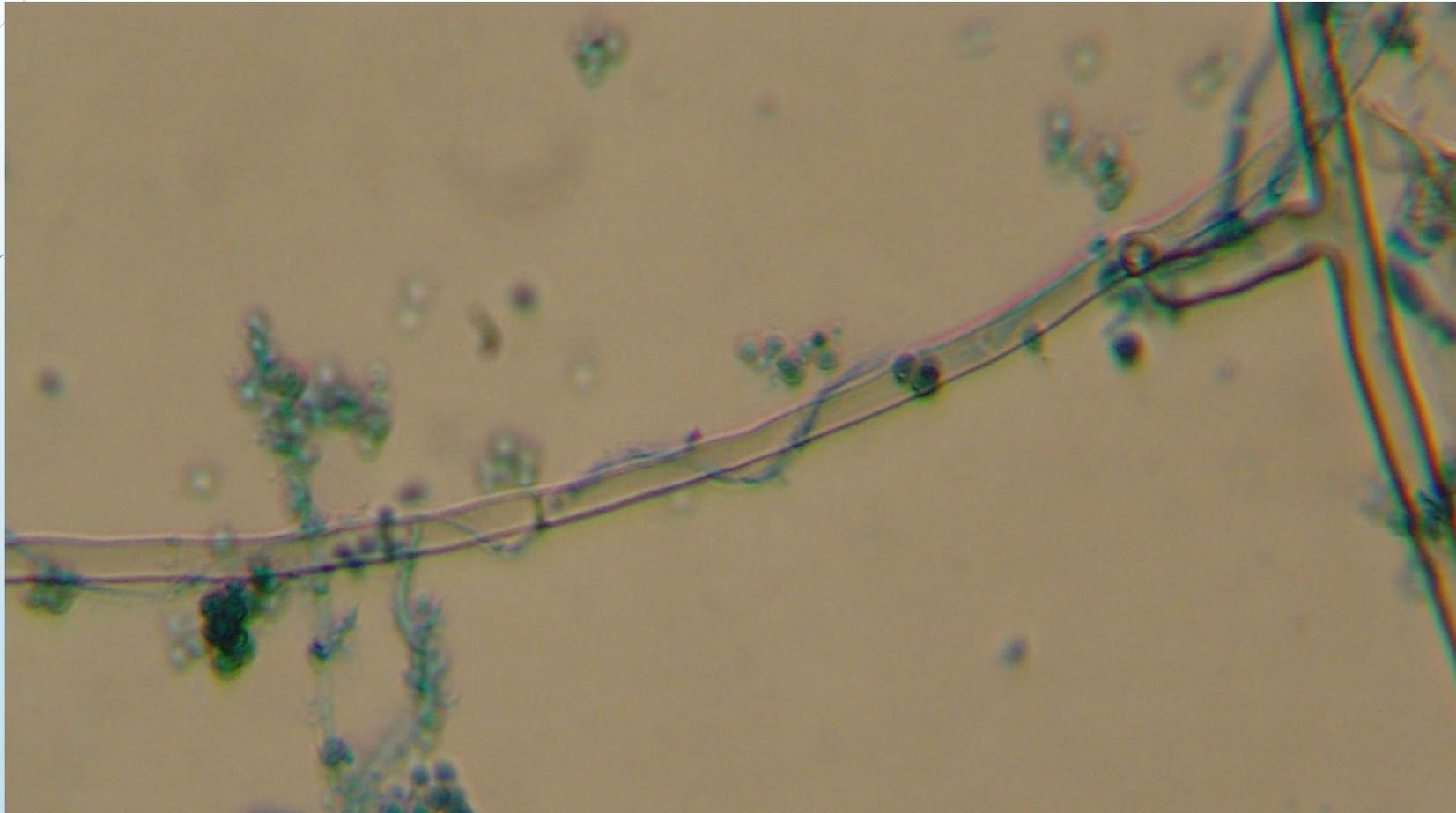
estructuras similares a los esporios



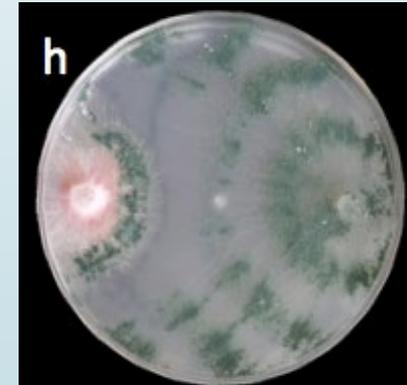
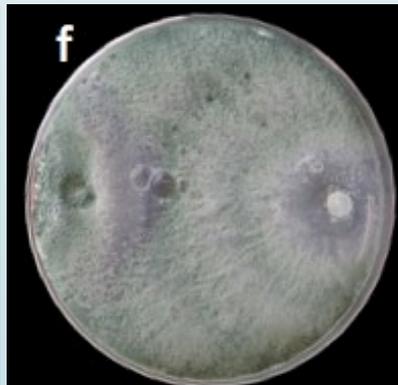
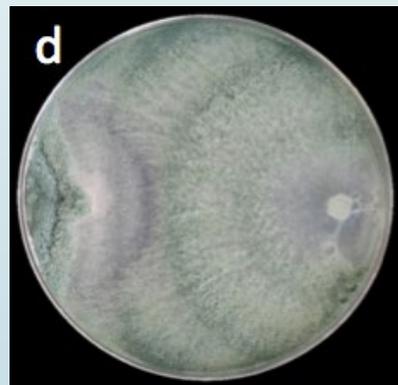
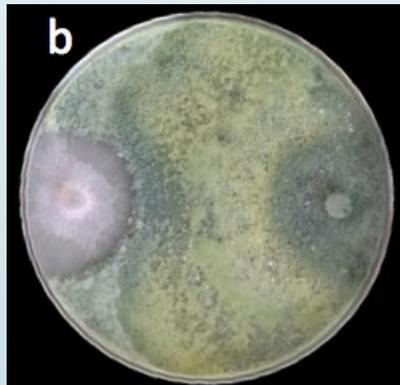
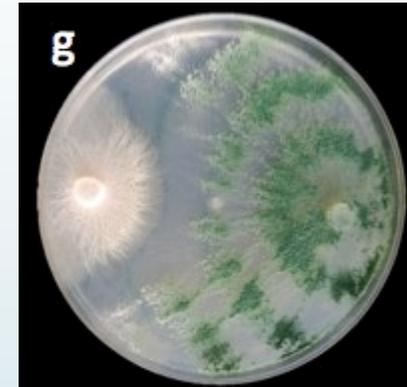
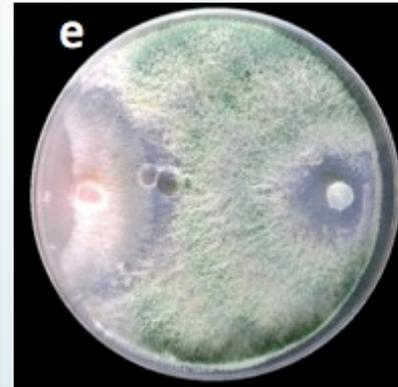
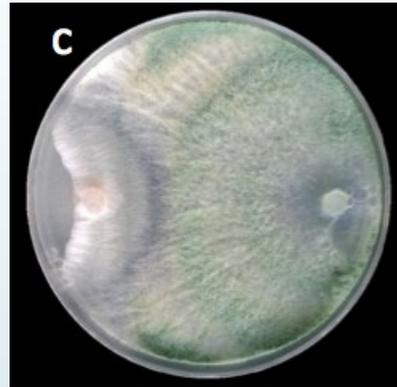
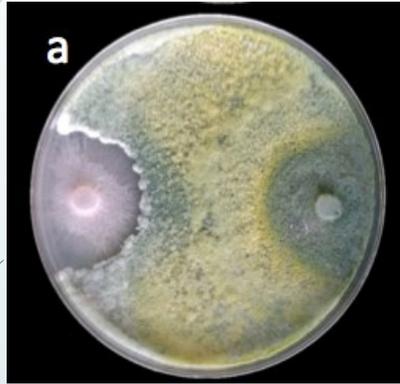
Antagonismo
vs
Rhizoctonia solani



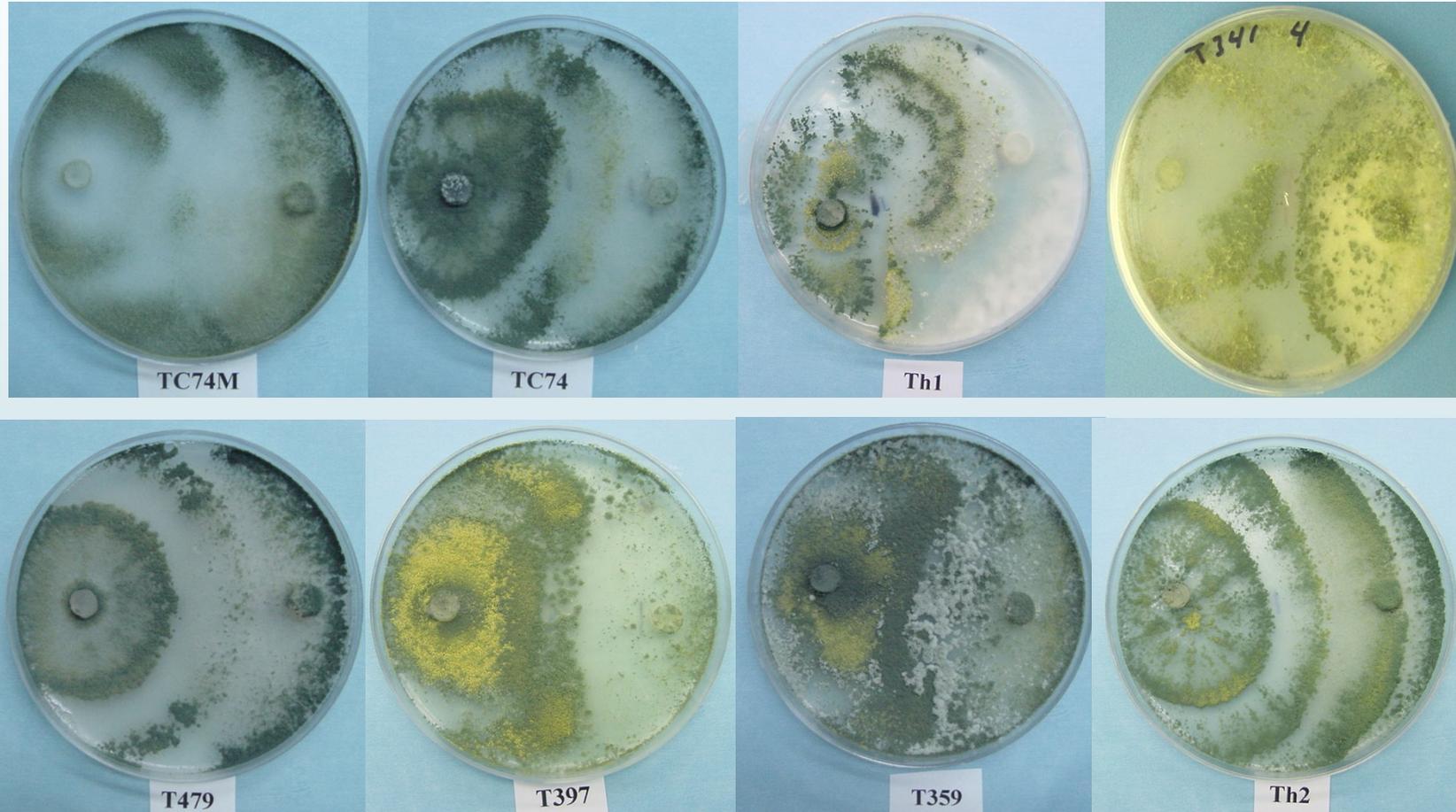
T359 vs Rhizoctonia



Antagonismo
vs
Fusarium spp.



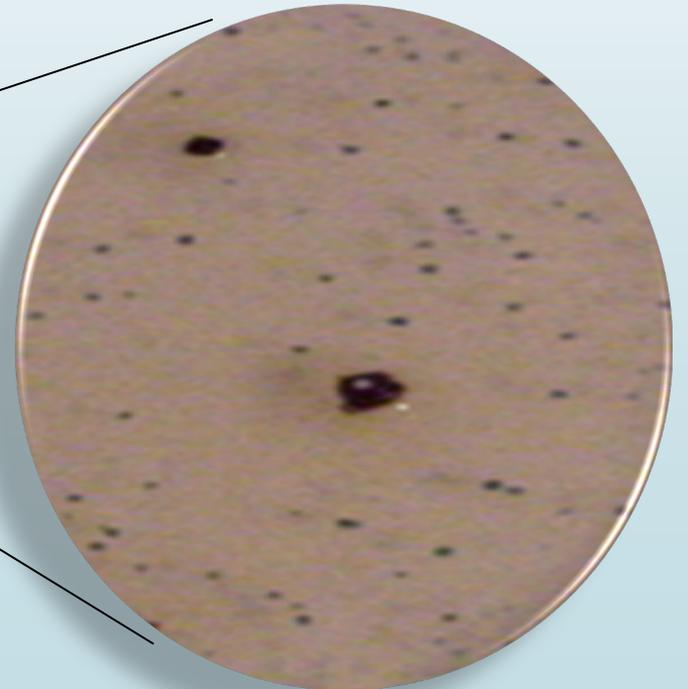
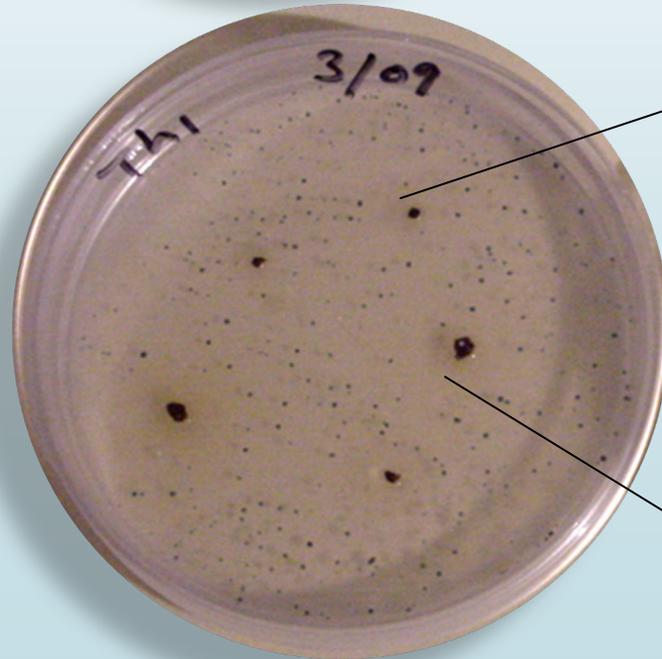
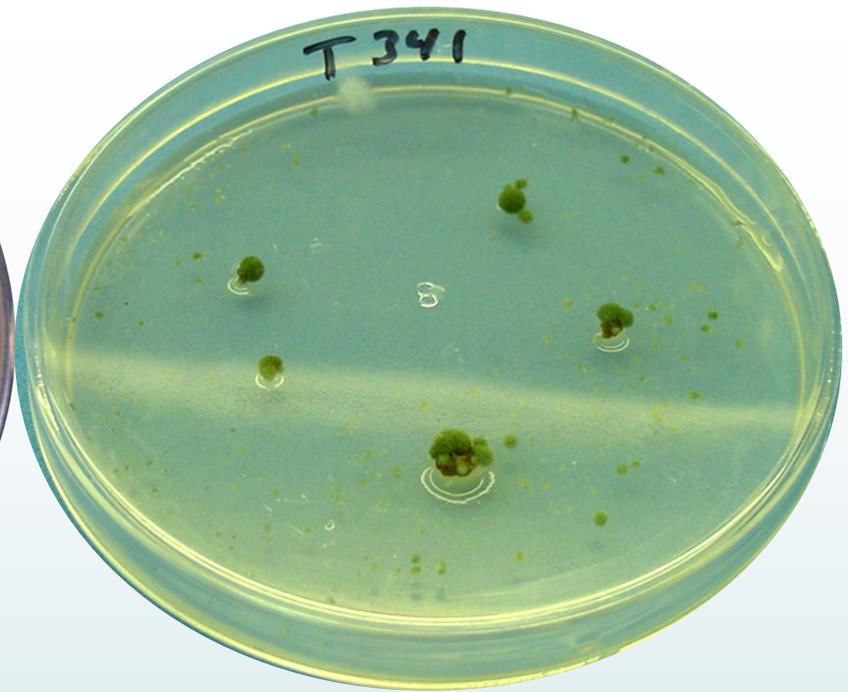
Antagonismo vs Micelio de *P. omnivora*



Antagonismo

VS

Esclerocios de *P. omnivora*





Producción de proteínas:
Buena (18-20 $\mu\text{g}/\text{mL}$)

Producción de proteínas: T341>T22>TC74
6 relacionadas con biocontrol

Cinética

NAGasa similar entre cepas, mayor a 5ddi

Endoquitinasa variable entre cepas, mayor a 5 ddi

β 1,3 glucanasa mas variables mayores a 3, 5 y 10 ddi

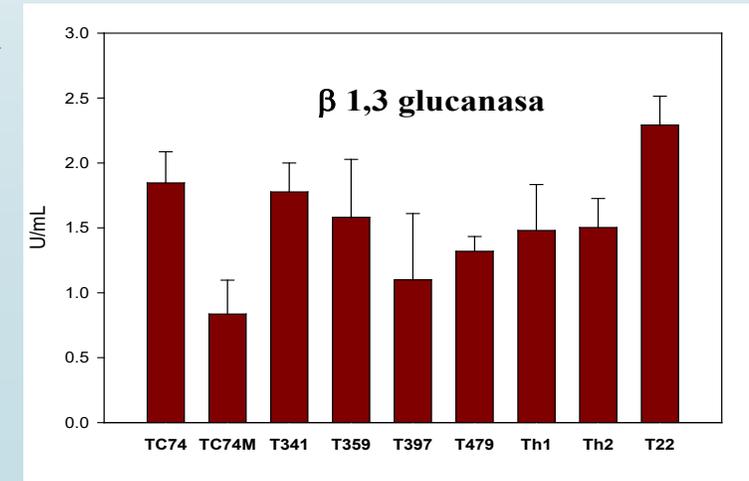
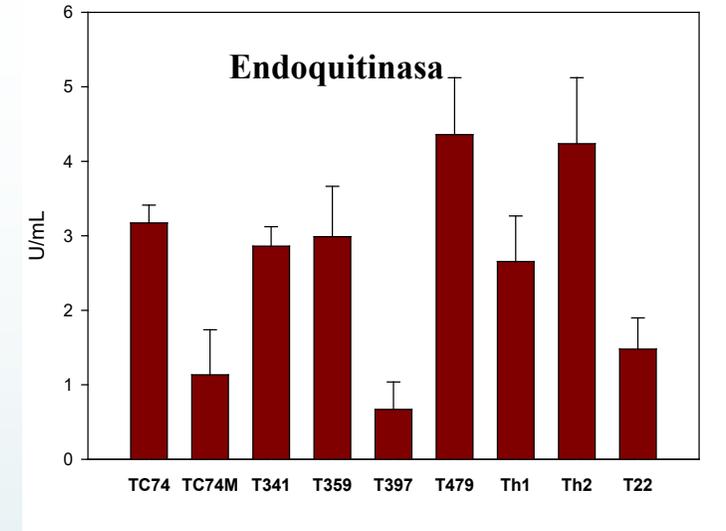
Actividad promedio

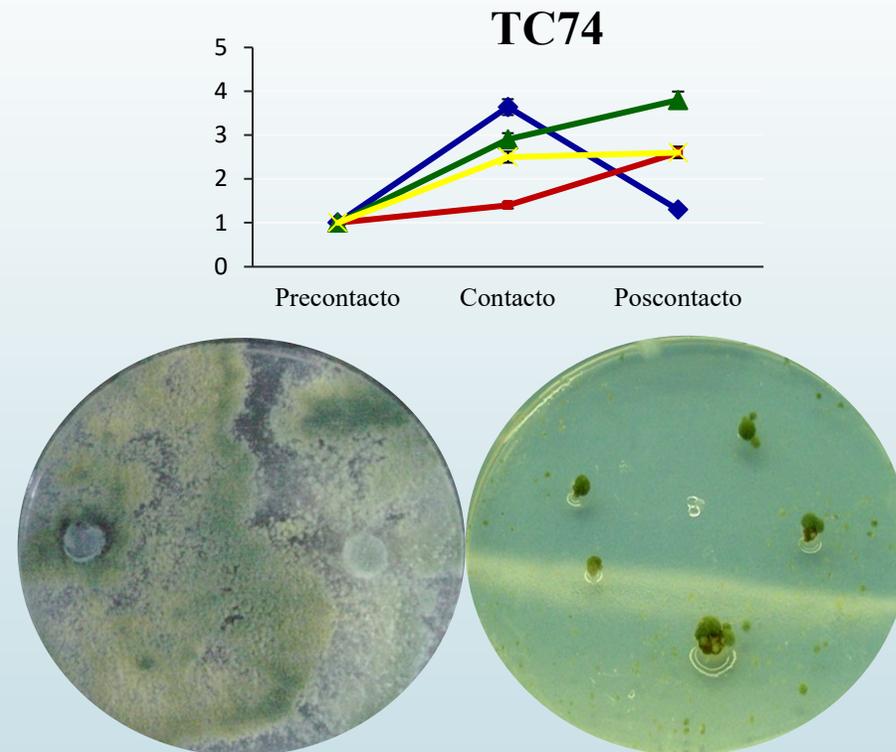
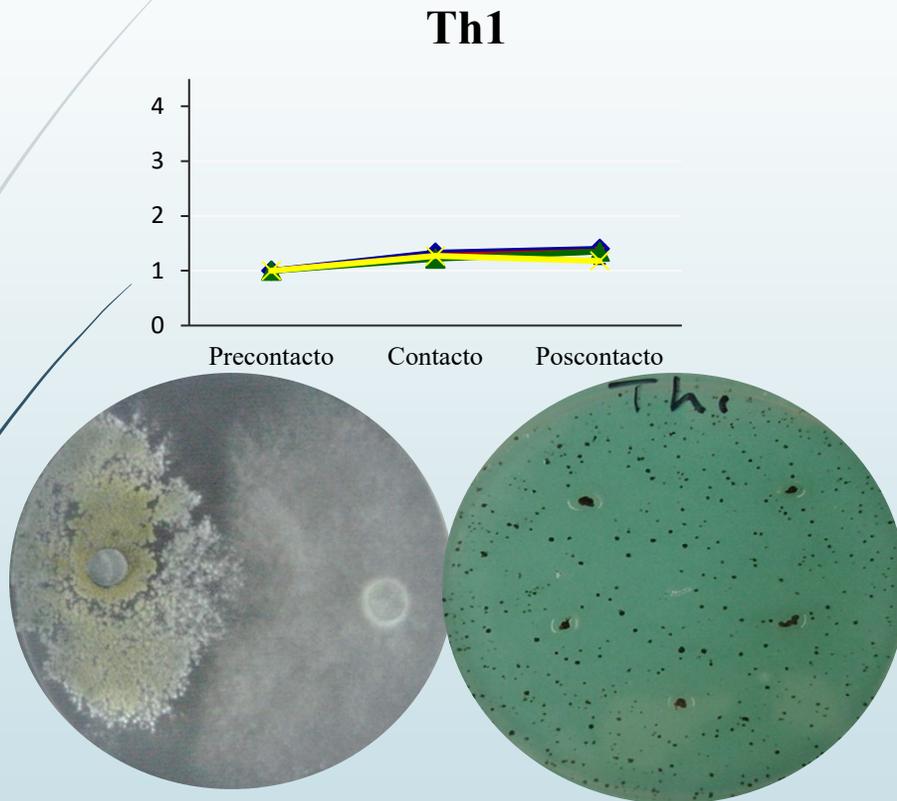
NAGasa Th1> T359>T22

Endoquitinasa T479> Th2> TC74 >T22

β 1,3 glucanasa TC74>T341>T359 <T22

Producción de xilanasas y celulasas: Pobre

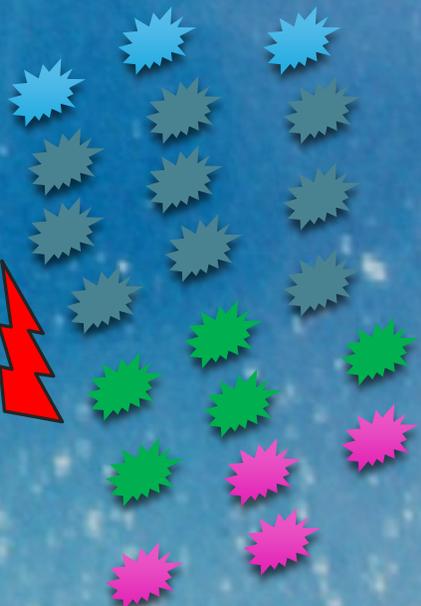




- Diferencias en los promotores de los genes (Benitez *et al.* 2004; Massart y Jijakli, 2007)
- Cambios en la polaridad-Insensibilidad (Zeilinger *et al.* 2005)

P. omnivora

H



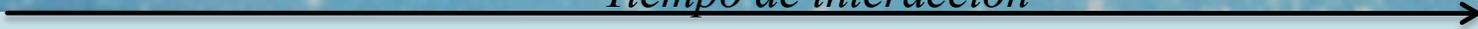
enqui
NAGasa
exg290
exg343



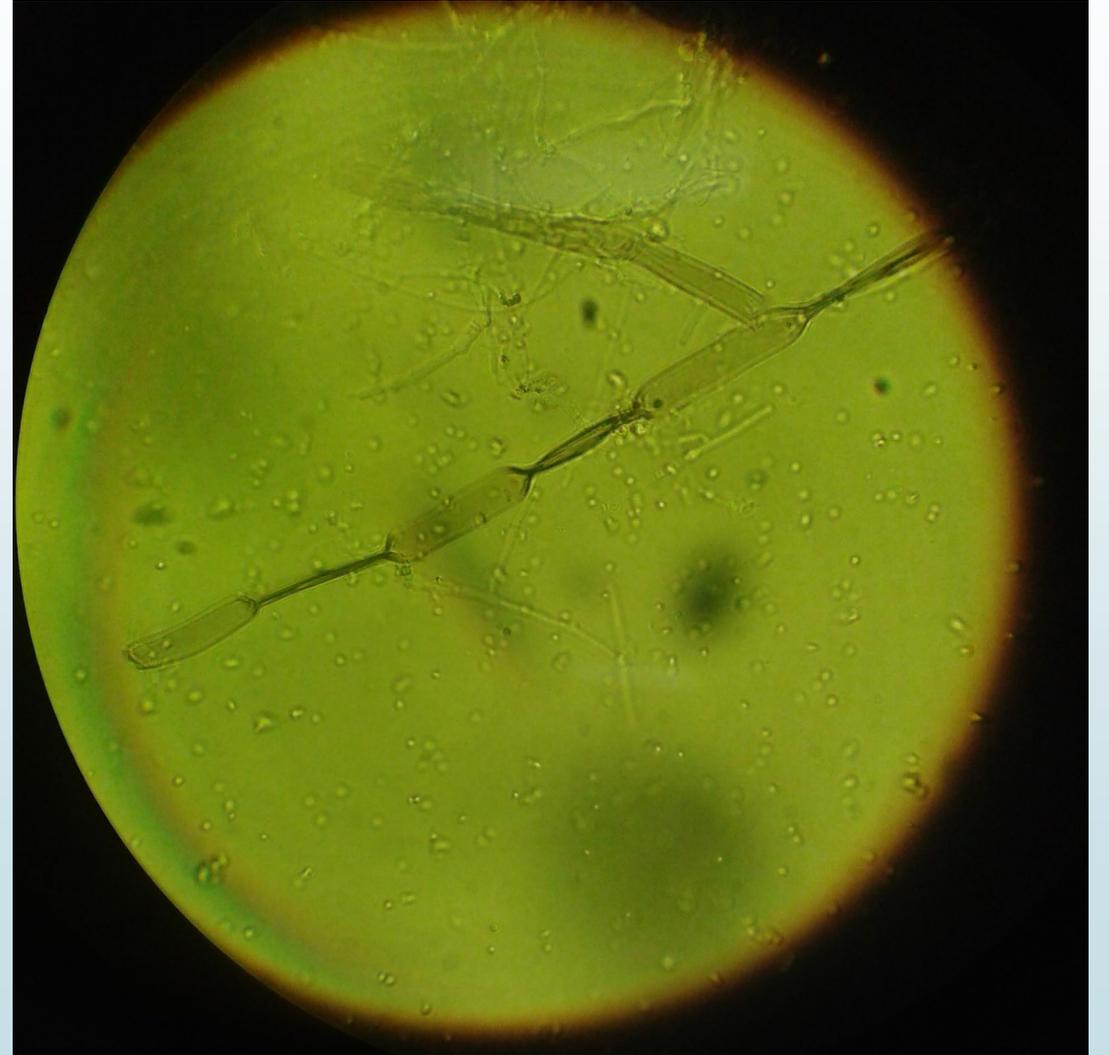
T

T. Asperellum TC74

Tiempo de interacción



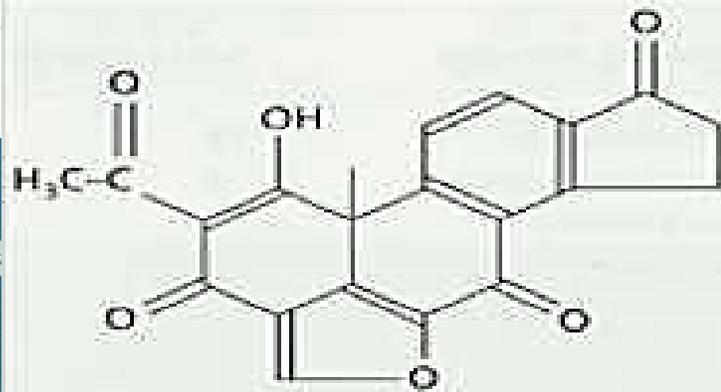
Antibiosis



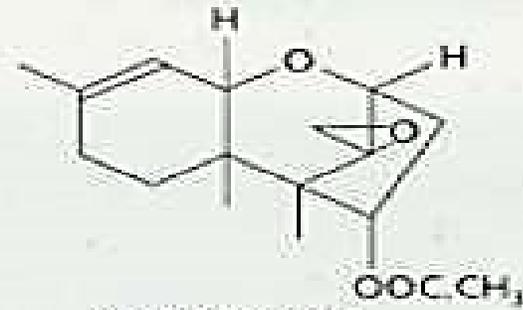
Antibiosis

P. omniv

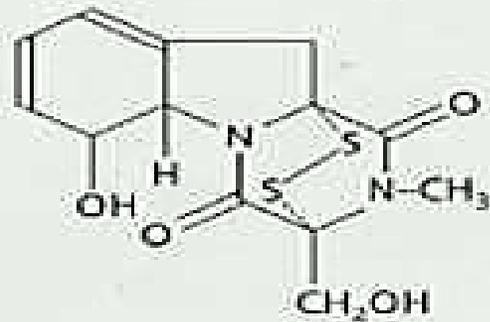
T397



Viridin



Trichodermin



Gliotoxin

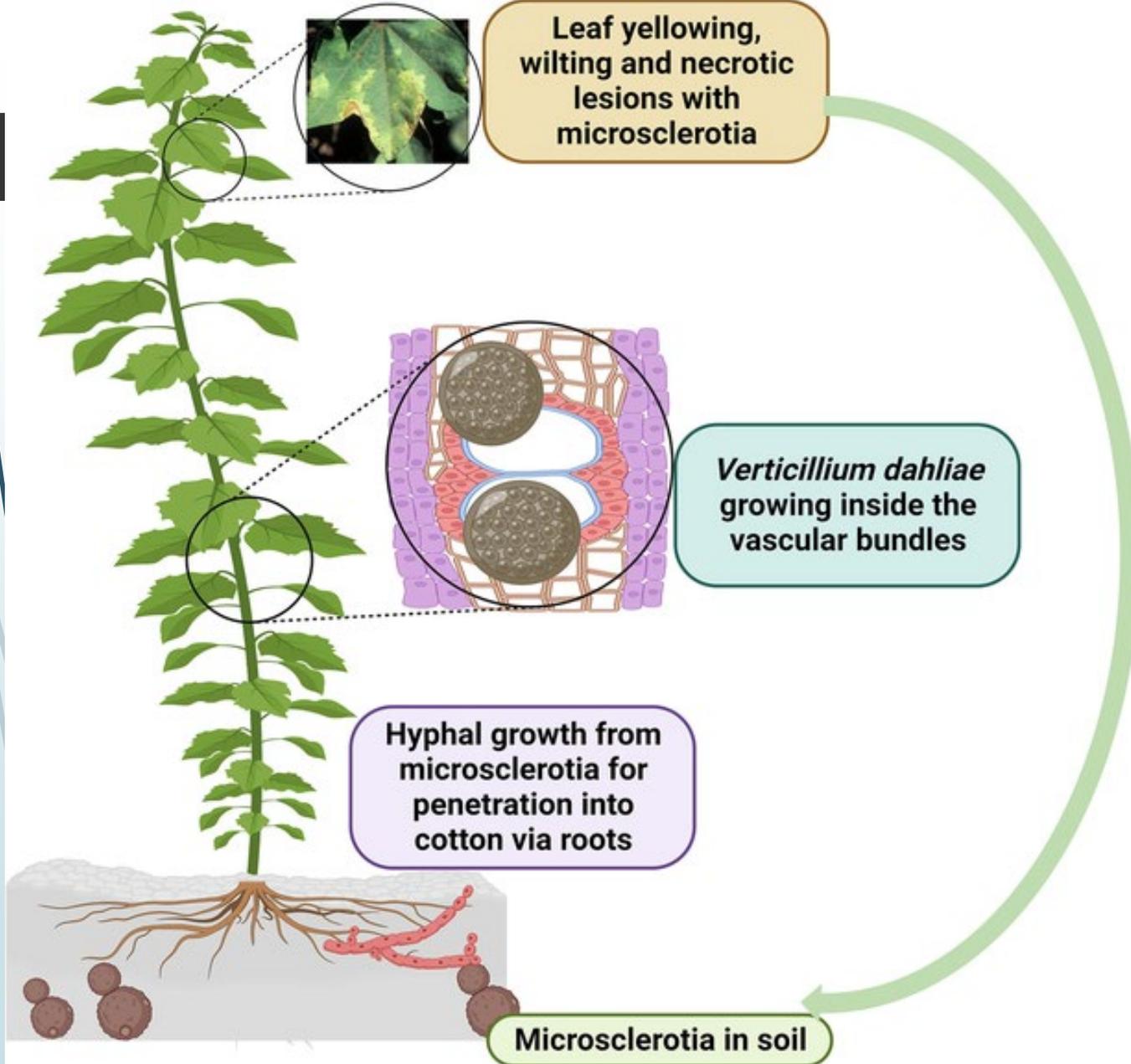


6n-Pentyl-2H-pyran-2-one
(6-PAP)

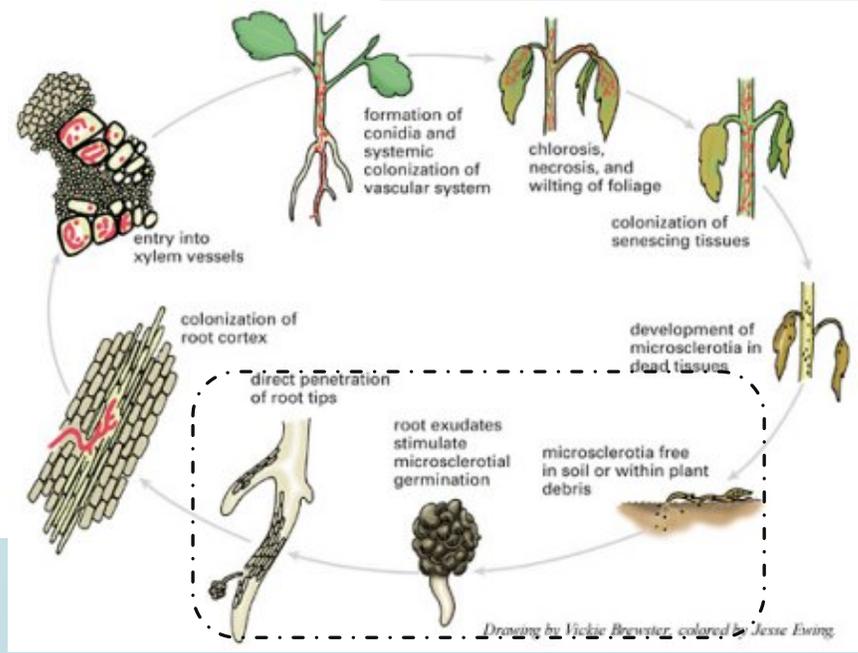
479

Th2

Inducción de Resistencia

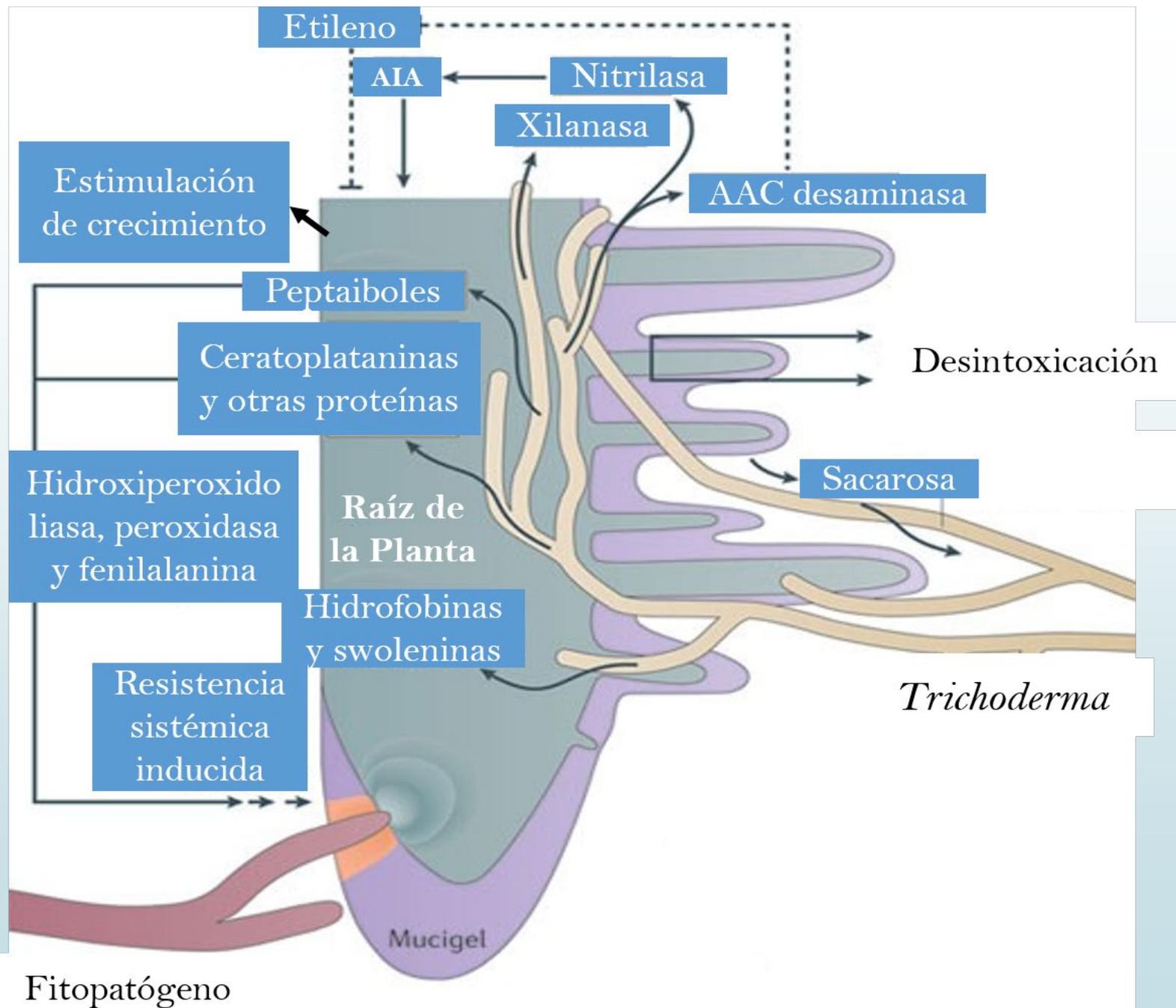


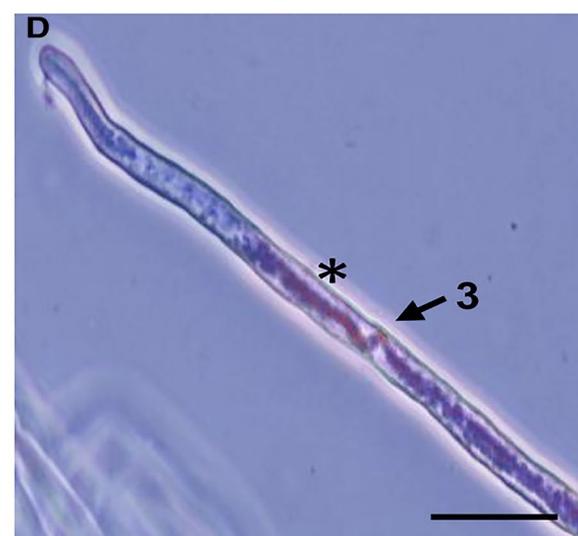
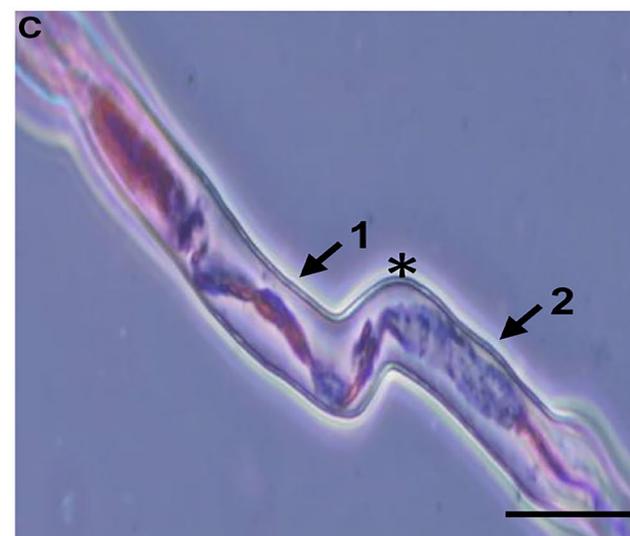
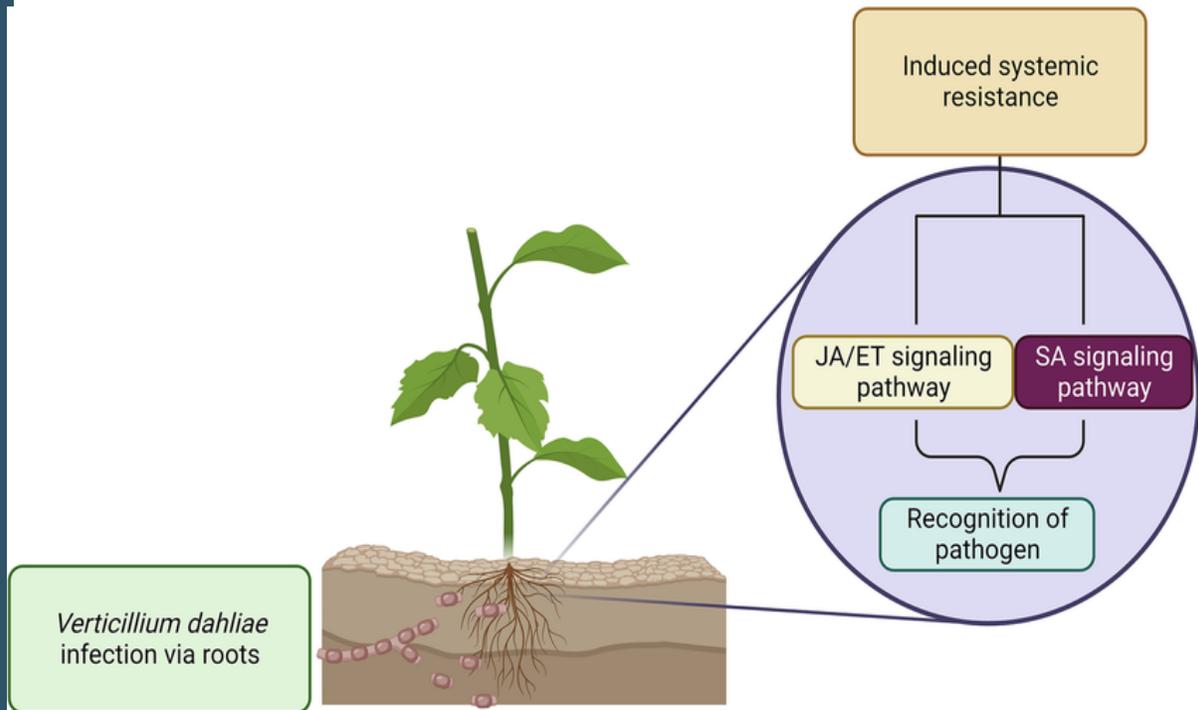
Cotton infection cycle of *Verticillium dahliae*

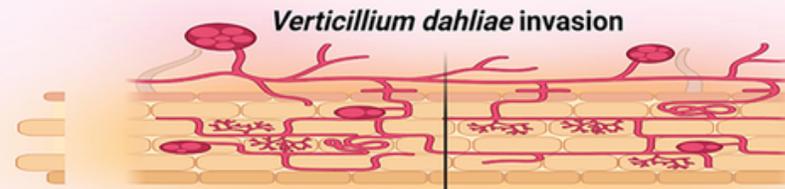
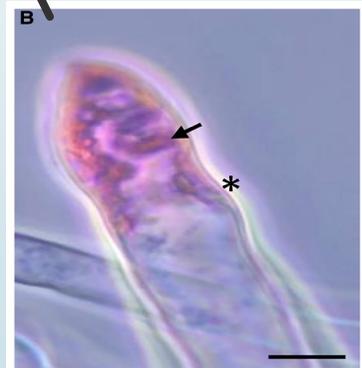
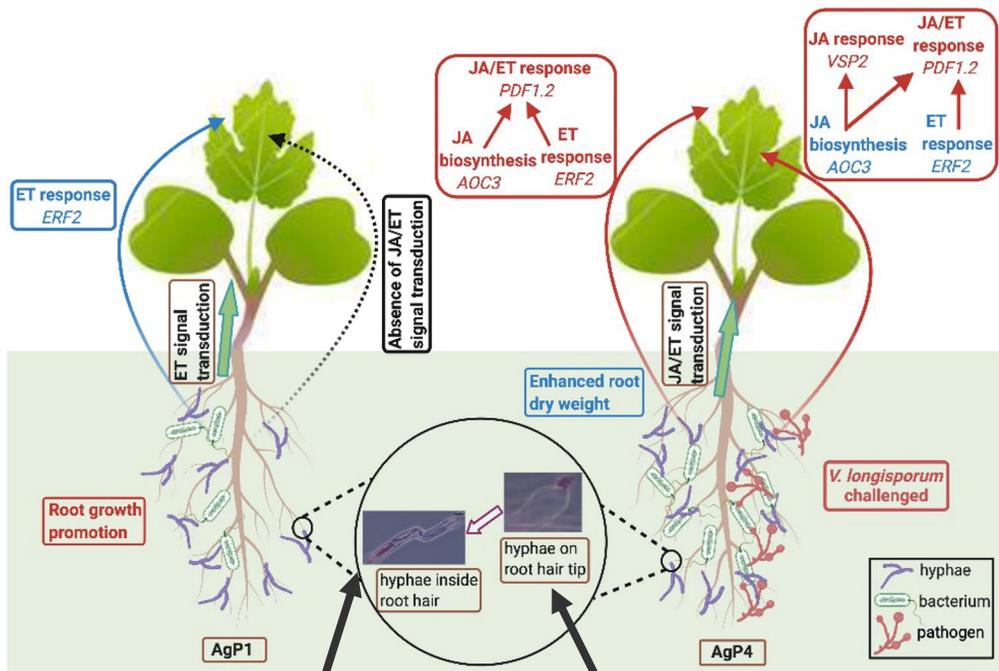


Algunas
enzimas que
pueden
participar son
fenil-alanina
amonio-liasa y
chalcona
sintasa

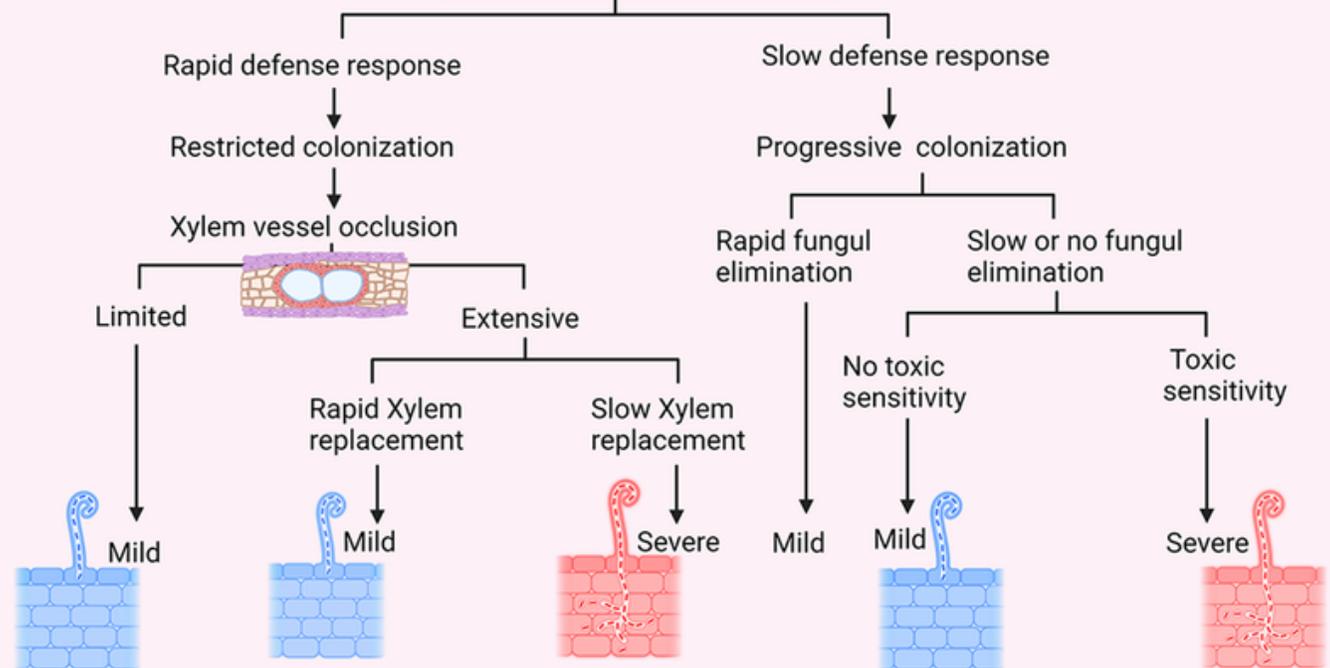
(Benítez *et al.*, 2004).

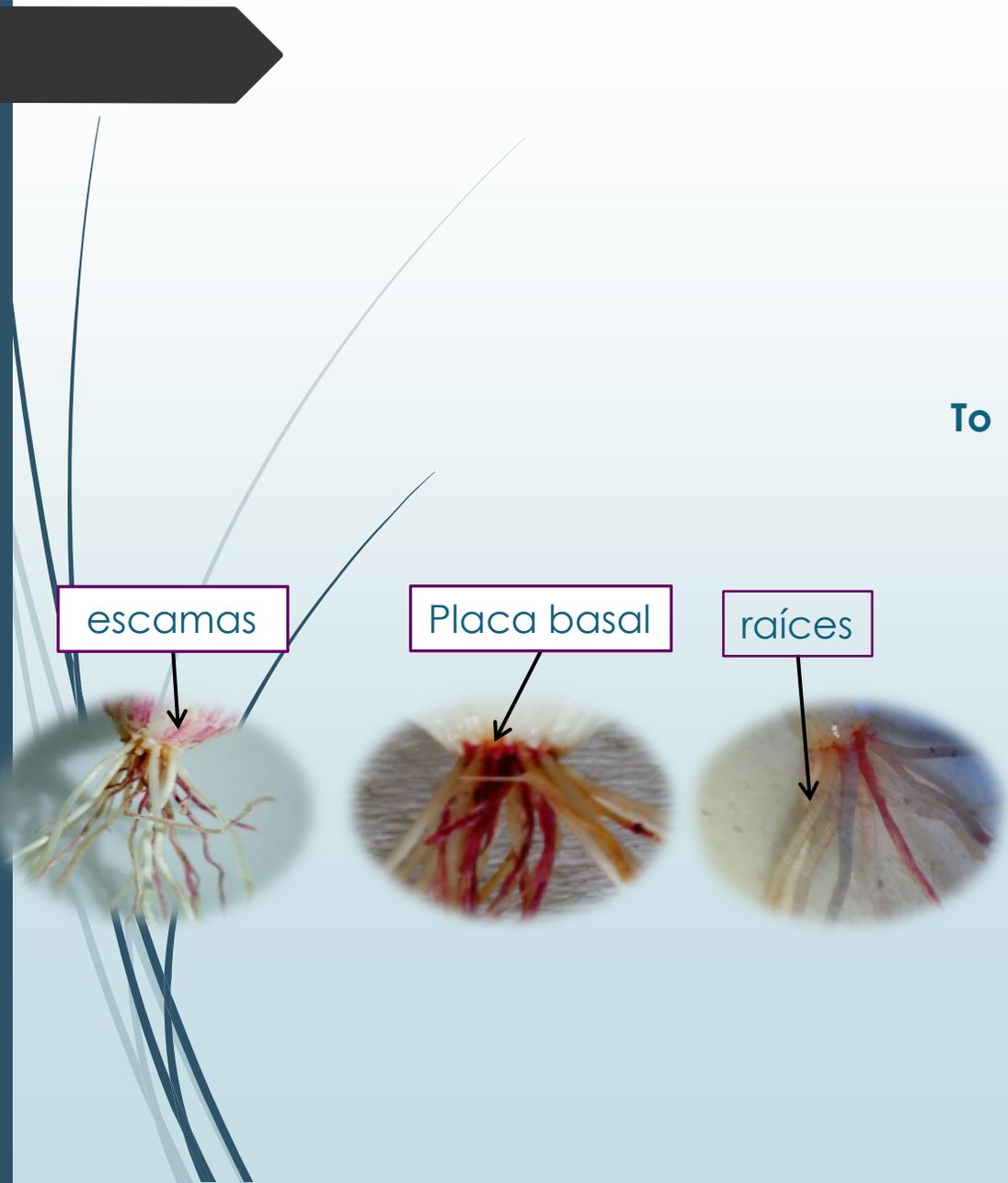




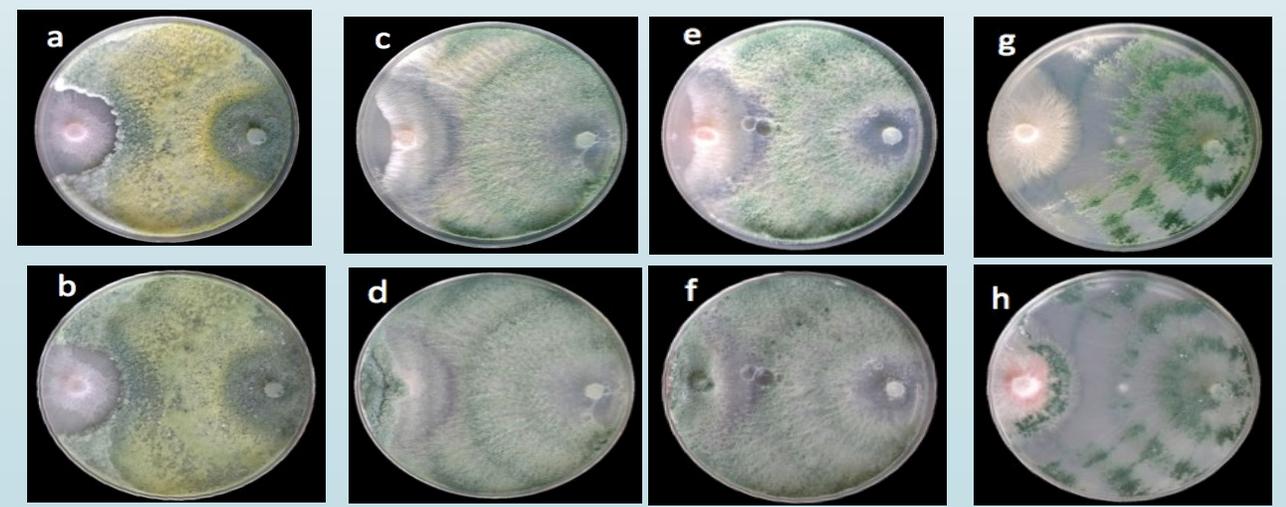
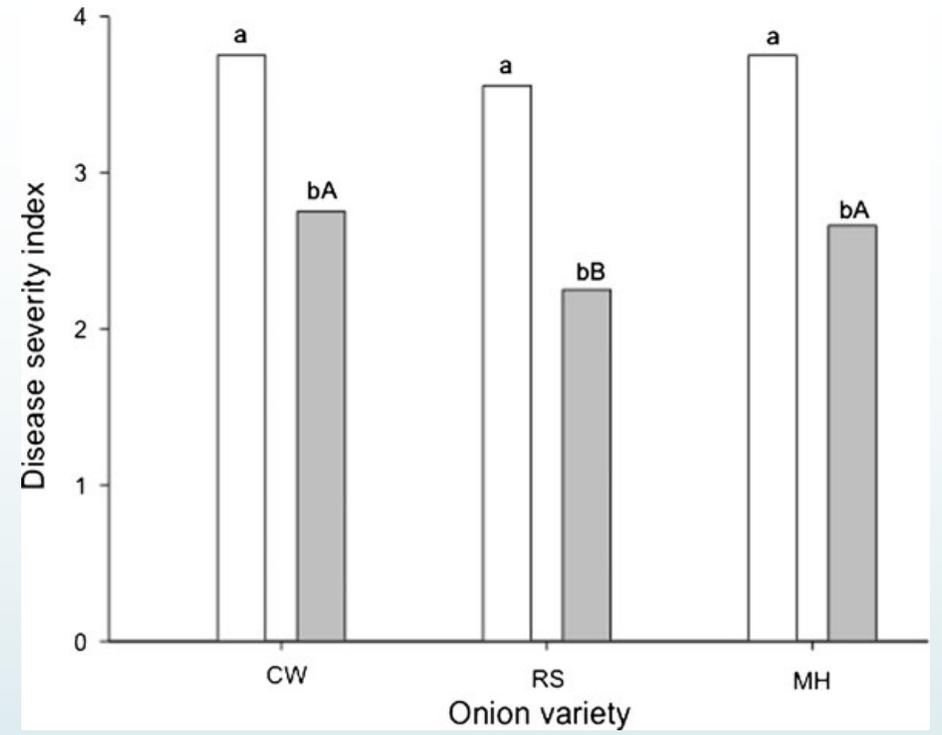


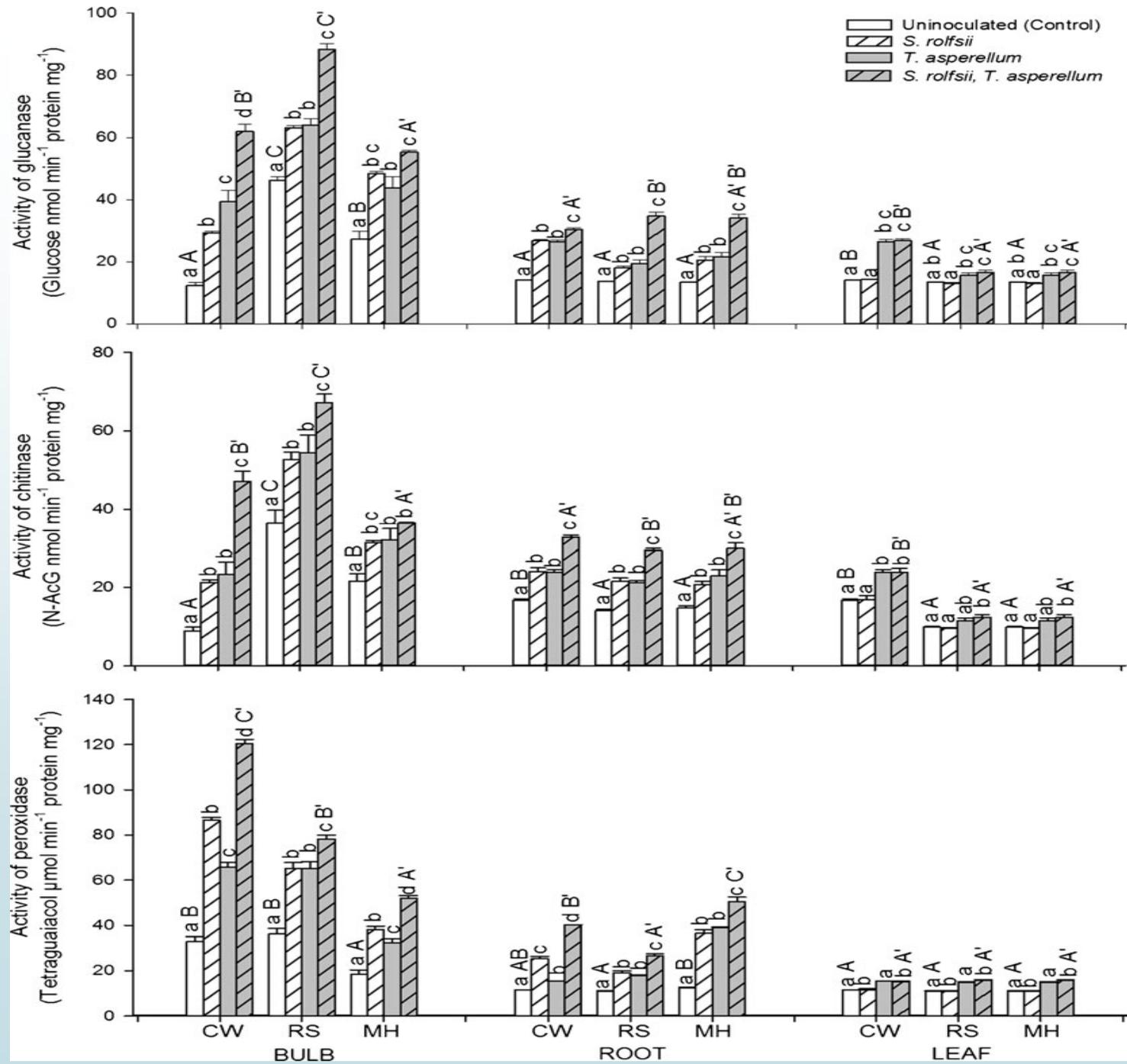
Vascular infection





To





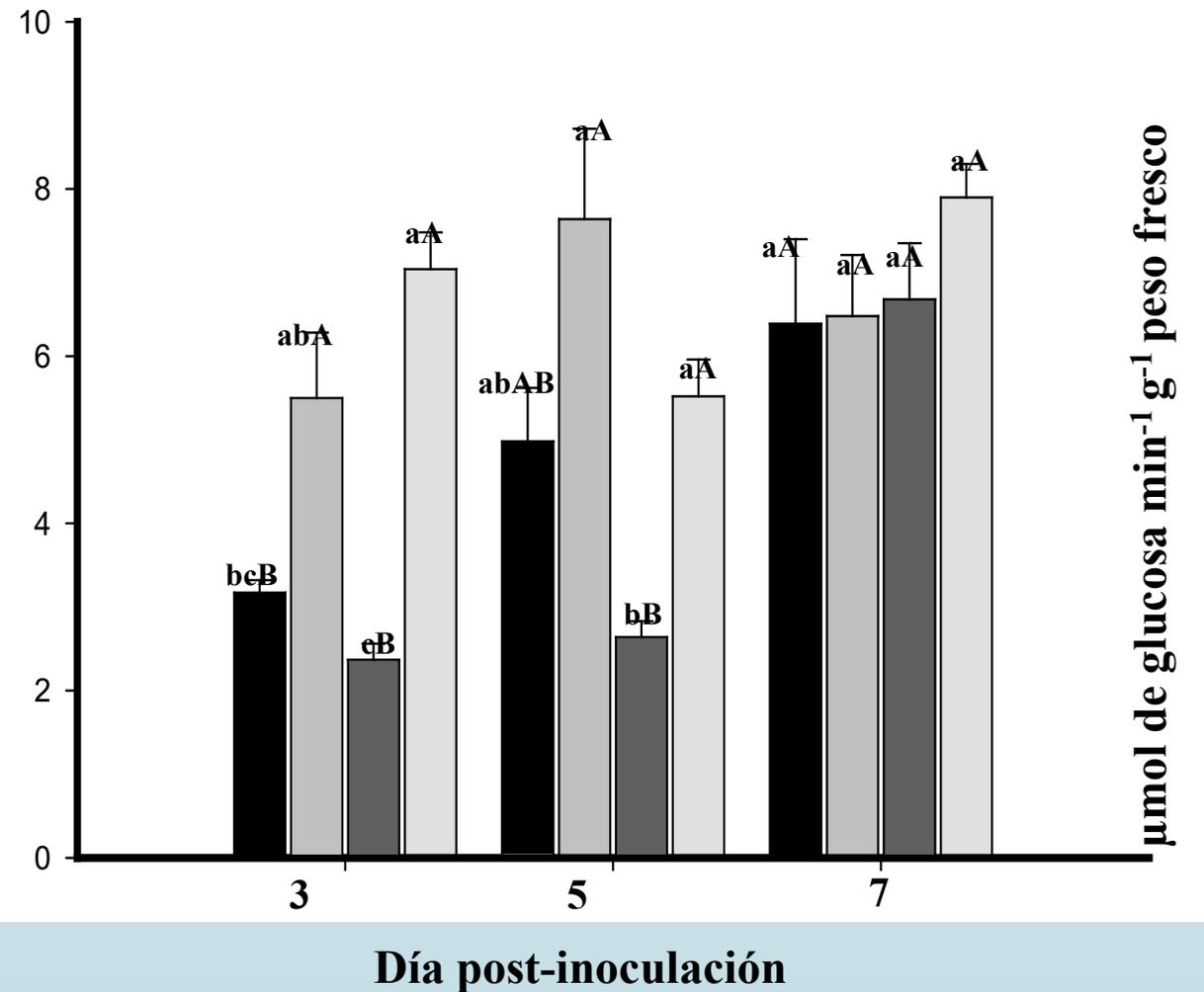
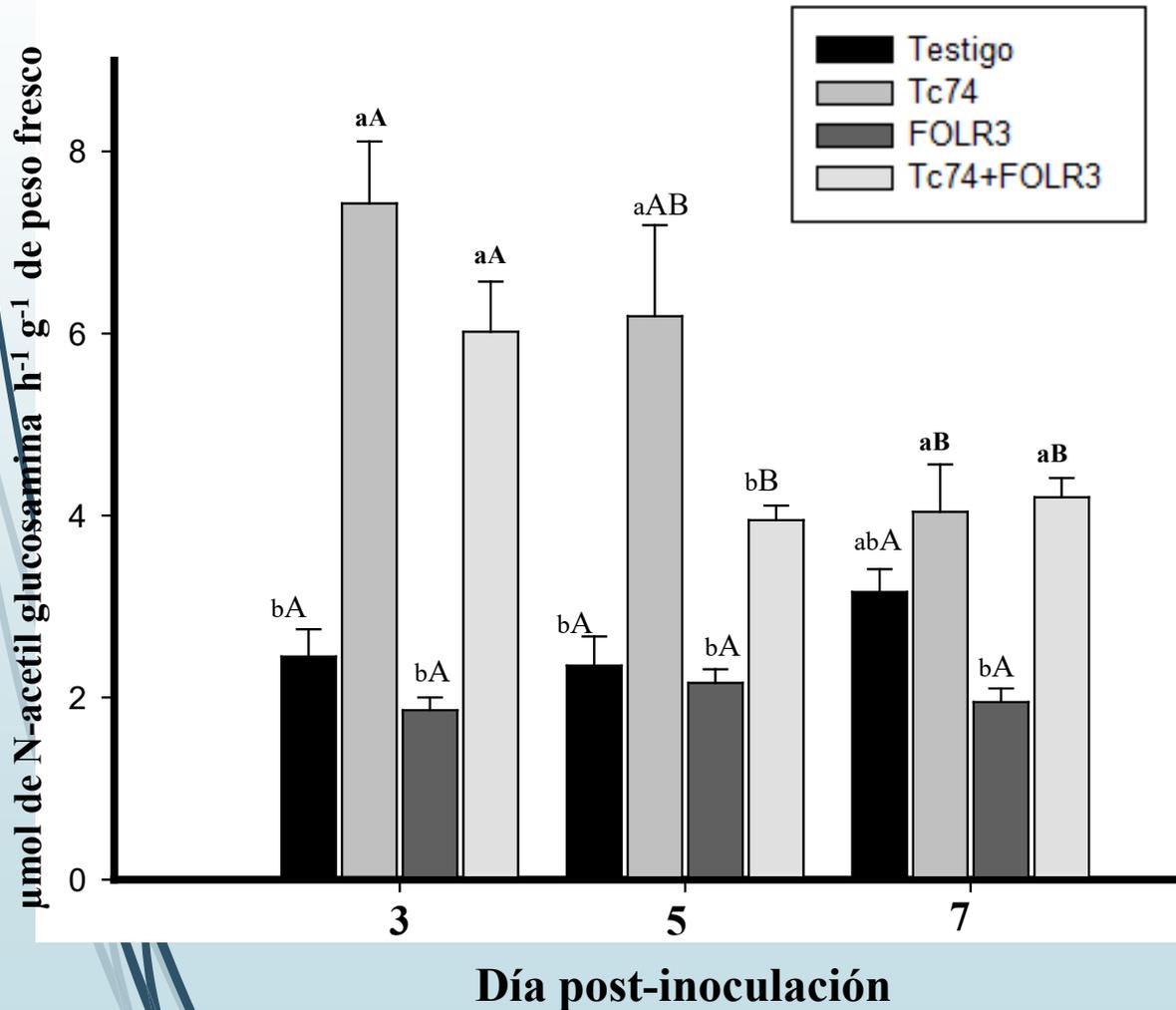
Efecto de Tc74 en la marchitez vascular del tomate



	Testigo	FOL R3	TC74	TC74+FOL R3
Variable				
Altura de planta ¹	53.64±1.052 b	47.09±0.471 c	63.49±1.297 a	51.59±0.711 b
Peso fresco de follaje ¹	19.78±0.681 b	15.81± 0.525 c	26.72±2.551 a	17.94±0.676 bc
Peso fresco raíz ₂	8.79±0.285 a	8.08±0.327 ab	8.89±0.369 a	7.15±0.369 b

($P = <0.001$) y la prueba de Tukey ($P < 0.050$), 2($P = 0.001$) y la prueba de Tukey ($P < 0.05$).

Actividad de quitinasas en raíz y follaje de plantas de tomate inoculadas con *Fusarium oxysporum lycopersici* R3









***T. asperellum* mejora el crecimiento de las plantas de chile:**

30% en altura (P<.001)

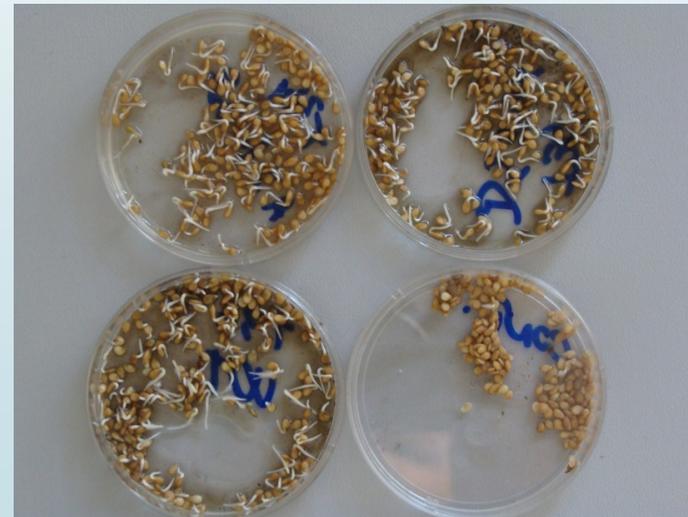
20% en número de hojas (P<.003)

30% en área foliar (P<.001)

15% en grosor de tallos (P<.002)

38% en biomasa del follaje (P<.001)

60% en biomasa de la raíz (P<.02)



Y en el algodónero????





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