



‘Seminario cancos dos ramos da macieira’



ORGANIZAÇÃO:
Centro de Pesquisa Proterra e
Universidade de Caxias do Sul



‘Espécies de Botryosphaeriaceae associadas aos cancos e á morte descendente das macieiras: Etiología, epidemiología e controle no Chile’



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24 de março 2026

Tópicos de presentación

- Antecedentes internacionales y nacionales
- Etiología
 - Síntomas
 - Prevalencia
 - Agentes causales
 - Patogenicidad
- Epidemiología
 - Ciclo de la enfermedad
 - Fuentes de inóculo
 - Liberación de conidias
 - Heridas de poda
 - Protección



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DISEASE NOTES

Diplodia seriata Associated with Botryosphaeria Canker and Dieback in Apple Trees in Chile

G. A. Díaz, L. Mostert, F. Halleen, M. Lolas, M. Gutierrez, E. Ferrada, and B. A. Latorre

Affiliations

Published Online: 11 Mar 2019 | <https://doi.org/10.1094/PDIS-10-18-1785-PDN>



During 2017 and 2018, a survey of diseased apple trees (*Malus × domestica*) was conducted in seven commercial orchards of cultivars Cripps Pink, Fuji, Granny Smith, and Royal Gala located in central Chile (34°09' to 35°26' S). Symptoms on branches and twigs could be observed from October to April on >7-year-old apple trees and were characterized by short internodes and dead twigs and branches. Cross sections of twigs and branches revealed brown wedge-shaped cankers with a hard consistency. The prevalence of

<https://doi.org/10.1094/PDIS-10-18-1785-PDN>

Details Figures Literature Cited Related



Vol. 103, No. 5

May 2019

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ISSN: 0191-2917
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Caption

Tomato leaves infected with *Tomato chlorotic dwarf viroid* (Olmedo-Velarde, Roy, Belanger, Watanabe, Hamasaki,

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RESEARCH

Characterization and Pathogenicity of *Diplodia*, *Lasiodiplodia*, and *Neofusicoccum* Species Causing Botryosphaeria Canker and Dieback of Apple Trees in Central Chile

Gonzalo A. Díaz, Adrián Valdez, Francois Halleen, Enrique Ferrada, Mauricio Lolas, and Bernardo A. Latorre

Affiliations

Published Online: 6 Mar 2022 | <https://doi.org/10.1094/PDIS-06-21-1291-RE>



Abstract

In recent years, the number of apple trees affected by Botryosphaeria cankers and dieback has considerably increased in central Chile. This study aimed to identify the species of Botryosphaeriaceae associated with canker and dieback symptoms, estimate disease incidence and distributions, and study their pathogenicity and virulence on apple and other fruit crops. A field survey of 34 commercial orchards of

RESEARCH

Efficacy of Pruning-Wound Protectant Fungicides for the Management of Botryosphaeria Canker and Dieback of Apple Trees in Maule Region, Chile

Adrián Valdez-Tenezaca, Mauricio A. Lolas, Fernanda B. Núñez, Bernardo A. Latorre, Lizel Mostert, Francois Halleen, Enrique Ferrada, and Gonzalo A. Díaz

Affiliations

Published Online: 18 Oct 2025 | <https://doi.org/10.1094/PDIS-11-24-2427-RE>



Abstract

Botryosphaeria canker and dieback is an important fungal disease caused by Botryosphaeriaceae spp. that affects the productivity of apple orchards in Chile and worldwide. In the field, studies on the management of this disease are focused on the protection provide by fungicides applied on pruning wounds. However, in Chile, information about the protection and efficacy of fungicides on apple trees against twig and branch pathogens is scarce. Therefore, in this study, we evaluated the efficacy of fungicides to control fungal trunk pathogens causing Botryosphaeria canker and dieback in apple trees using in vitro, greenhouse, and field trials. Isolates of *Diplodia mutila*, *D. seriata*, *Neofusicoccum arbuti*, and *Lasiodiplodia theobromae* obtained and

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Dr. Adrián Valdez-Tenezaca (Ecuador)

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RESEARCH

Susceptibility of Pruning Wounds of Apple Trees to *Diplodia mutila*, *D. seriata*, *Lasiodiplodia theobromae*, and *Neofusicoccum arbuti* Infections and Conidial Release of Botryosphaeriaceae spp. in the Maule Region, Chile

Adrián Valdez-Tenezaca, Bernardo A. Latorre, and Gonzalo A. Díaz

Affiliations

Published Online: 14 May 2025 | <https://doi.org/10.1094/PDIS-07-24-1498-RE>



Abstract

Studies on the susceptibility of pruning wounds of different ages and the effect of pruning time on infection by Botryosphaeriaceae species in apple trees are scarce. This work aimed to determine the susceptibility of pruning wounds of different ages (1, 15, 30, or 45 days after pruning) and the effect of pruning time during early (June) and late pruning (August) in apple cultivars Fuji and Gala on the infection of *Diplodia*

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RESEARCH

Efficacy of Pruning-Wound Protectant Fungicides for the Management of Botryosphaeria Canker and Dieback of Apple Trees in Maule Region, Chile

Adrián Valdez-Tenezaca, Mauricio A. Lolas, Fernanda B. Núñez, Bernardo A. Latorre, Lizel Mostert, Francois Halleen, Enrique Ferrada, and Gonzalo A. Díaz

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Abstract

Botryosphaeria canker and dieback is an important fungal disease caused by Botryosphaeriaceae spp. that affects the productivity of apple orchards in Chile and worldwide. In the field, studies on the management of this disease are focused on the protection provide by fungicides applied on pruning wounds. However, in Chile, information about the protection and efficacy of fungicides on apple trees against twig and branch pathogens is scarce. Therefore, in this study, we evaluated the efficacy of fungicides to control fungal trunk pathogens causing Botryosphaeria canker and dieback in apple trees using in vitro, greenhouse, and field trials. Isolates of *Diplodia mutila*, *D. seriata*, *Neofusicoccum arbuti*, and *Lasiodiplodia theobromae* obtained and

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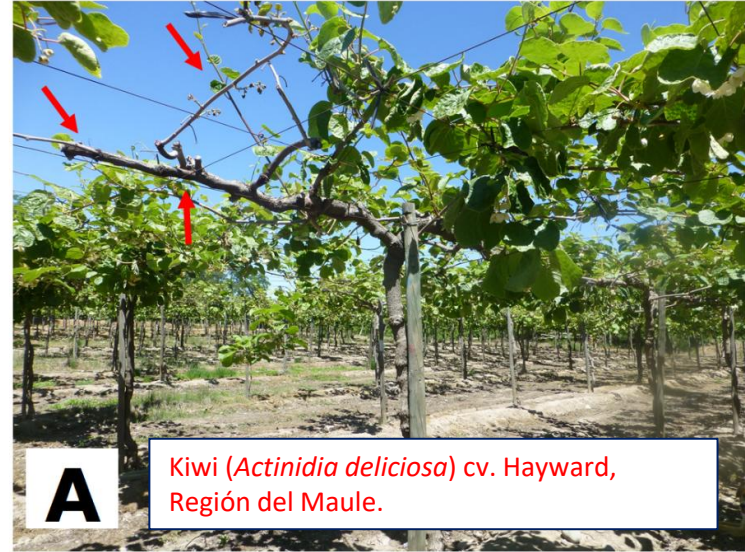
3 Total citations
3 Recent citations
n/a Field Citation Ratio
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<https://doi.org/10.1094/PDIS-11-24-2427-RE>

Muerte regresiva de brazos (dieback)



Manzano (*Malus domestica*) cv. Mac, Cleveland USA. G.Díaz



Kiwi (*Actinidia deliciosa*) cv. Hayward, Región del Maule.



Vid (*Vitis vinifera*) cv. Pinot Noir, Región de Valparaíso.

Cancros y muerte regresiva por Botryosphaeriaceae: Hospederos frutales en Chile

• Vides

- *Diplodia* spp. *Neofusicoccum* spp.

(Auger et al., 2004. Plant Dis; Díaz et al., 2011. Plant Dis. 95; Besoain et al., 2013. Plant Dis. 97; Díaz et al., 2013. Cien. Inv. Agr. 40; Larach et al., 2020).

• Nogales

- *D. mutila*; *Dothiorella sarmentorum*

(Díaz et al., 2018. Plant Dis. 102; Iqbal et al., 2023. Plant Dis. 107).

• Arándanos

- *Neofusicoccum australe*, *N. arbuti*, *N. parvum*.

(Espinoza et al., 2009. Plant Dis. 93).

• Kiwis

- *Diplodia seriata*, *D. mutila*, *N. parvum*

(Díaz et al., 2021. Plant Dis.).

• Avellano europeo

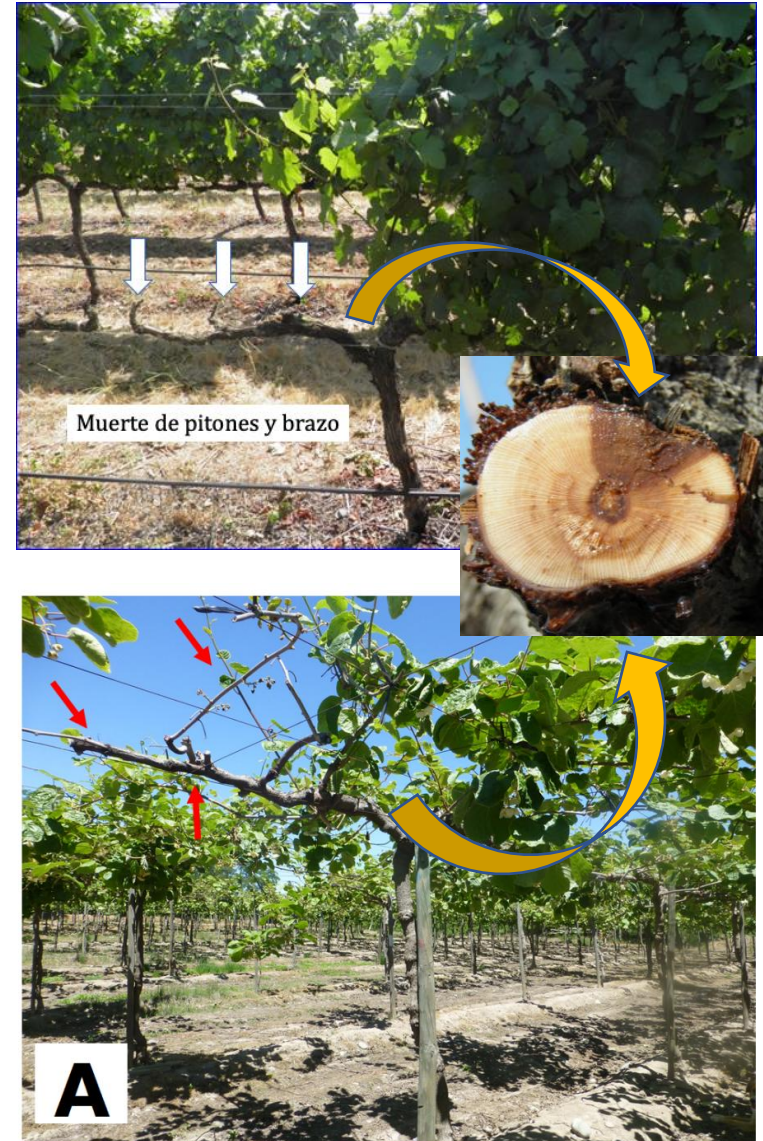
- *Diplodia coryli*, *D. mutila*, *N. parvum*

(Guerrero y Pérez, 2012. Plant Dis. 97; Moya-Elizondo et al. 2023. Plant Dis 107; Lolas et al., 2024).

• Paltos

- *Diplodia* spp., *Neofusicoccum* spp., *Lasiodiplodia theobromae*

(Valencia et al., 2019. Plant Dis. 103).



Internacional background: 'Etiology'



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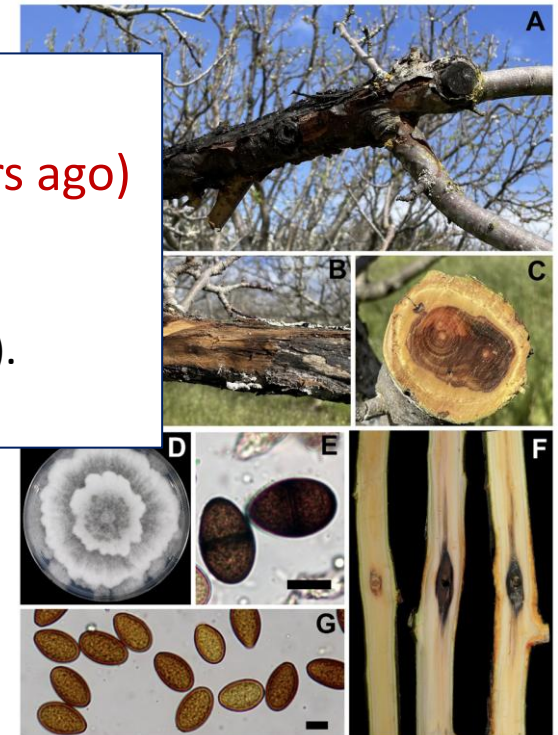
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DISEASE NOTE



First Report of *Diplodia bulgarica* Causing Black Canker on Apple in California

K. Elfar, C. Carachure, M. I. Bustamante, E. Andrews, and A. Eskalen



Incidence

- Worldwide and Chile: 5 to 15% (15 years ago)

-Now:

California: 10-30% (Elfar et al., 2024).
Canadá: 2% - 45% (Ilyukhin et al., 2022).
Argentina: 9 -29% (Lodolo et al., 2024)

USA

Carolina del Norte (Sutton and Boyne, 1983)

Botryosphaeria dothidea and *Diplodia seriata*

California (Rooney and Soriano, 2016; Elfar et al., 2024)

Neofusicoccum nonquaesitum and *D. bulgarica*

Brasil

- *Lasiodiplodia brasiliense* (Martins et al., 2018. Plant Dis.)
- *N. parvum* (Di Francesco et al., 2020. Eur. J. Plant Pathol.)

Canada

Ontario and British Columbia (Úrbez-Torres et al., 2016; Ilyukhin et al., 2022)

B. dothidea

China

(Xue et al., 2018)

Lasiodiplodia

Turkey

(Türkölmez et al., 2018)

B. dothidea

Iran

(Abdollahzadeh, et al., 2018)

D. bulgarica

South Africa

(Slippers et al., 2007; Cloete et al., 2011).

D. seriata, *Diplodia* sp. *N. australe* y *N. vitifusiforme*.

Argentina

(Lódolo et al., 2021)

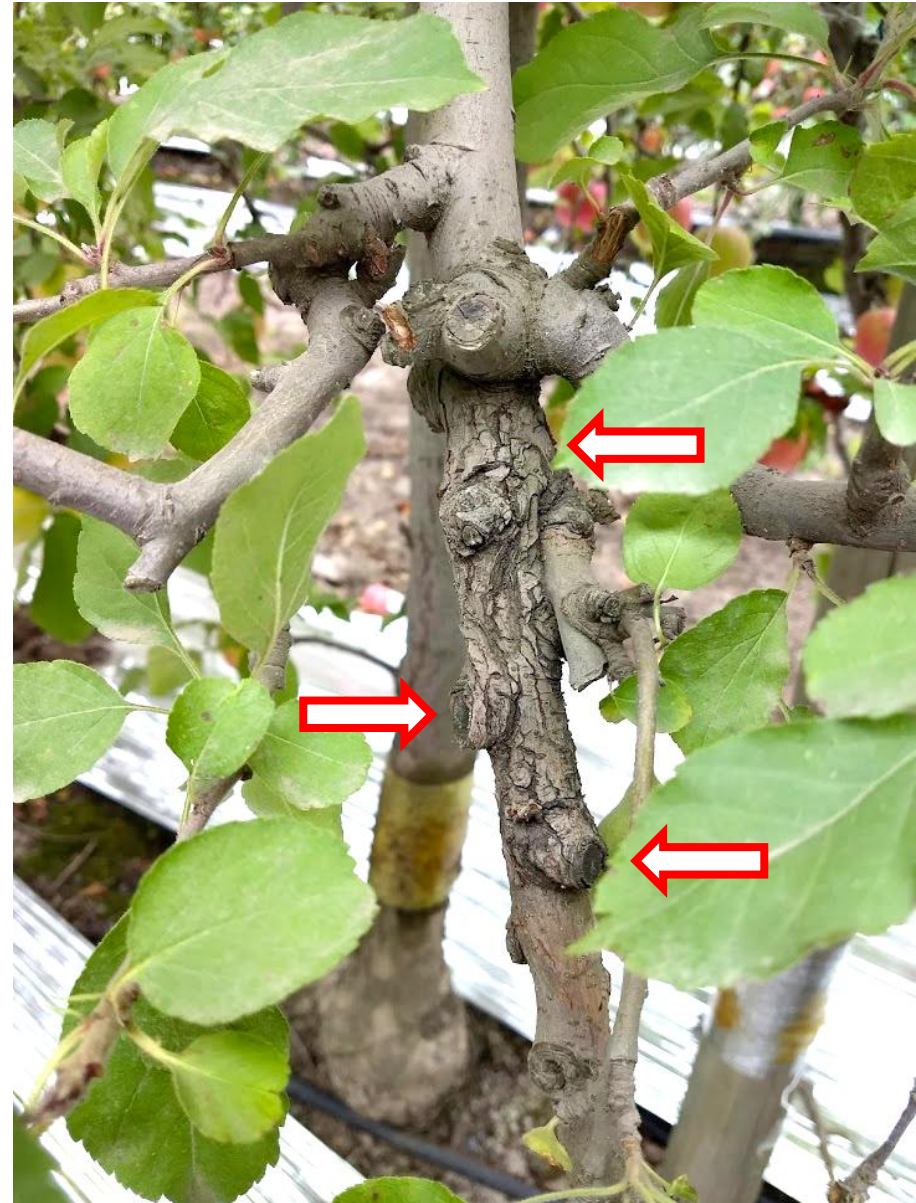
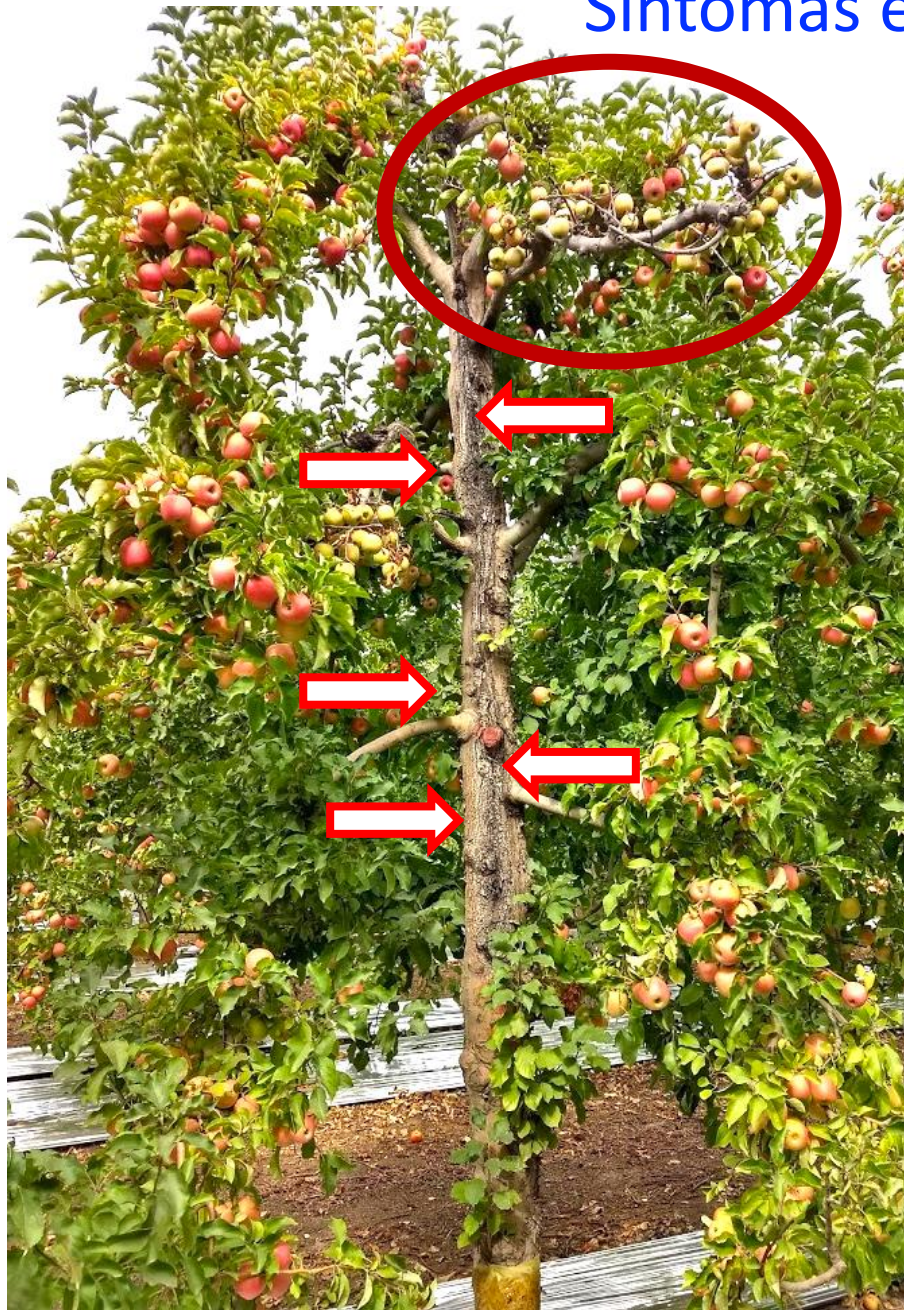
D. seriata, *D. mutila*, *Dothiorella omnivora*

Uruguay

(Sessa et al., 2016; Delgado-Cerrone et al., 2016)

B. dothidea, *D. seriata*, *D. mutila*, *D. pseudoseriata*, *Lasiodiplodia theobromae*, *N. australe*, *N. luteum* and *N. parvum*

Síntomas en manzanos (cancros)



Síntomas



Síntomas, necrosis de la
madera en corte longitudinal

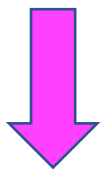


cv. Cripps Pink, Curicó

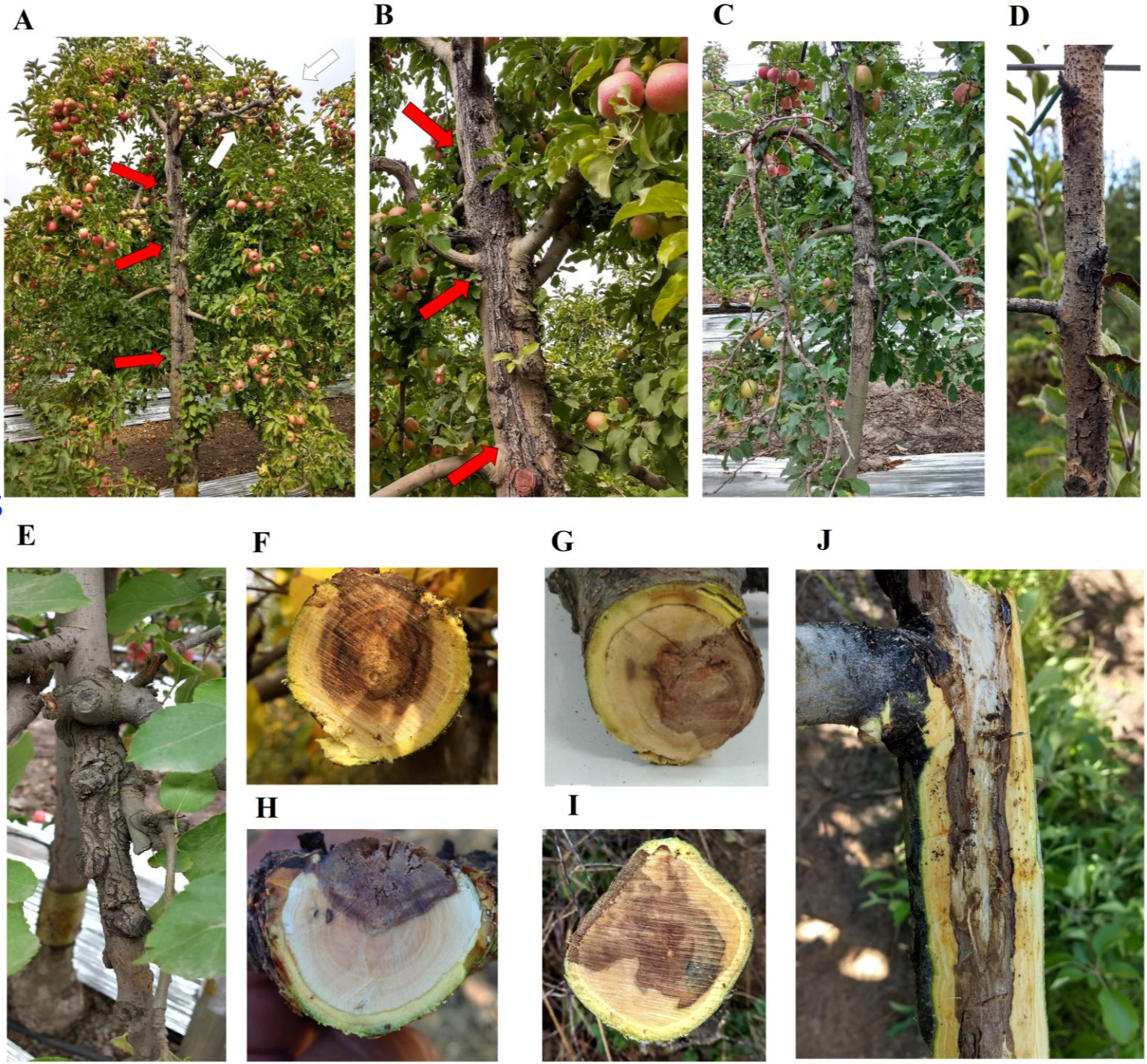
Cancros alargados que abarcan parte de brazos o tronco completos, necrosis de la madera

Síntomas

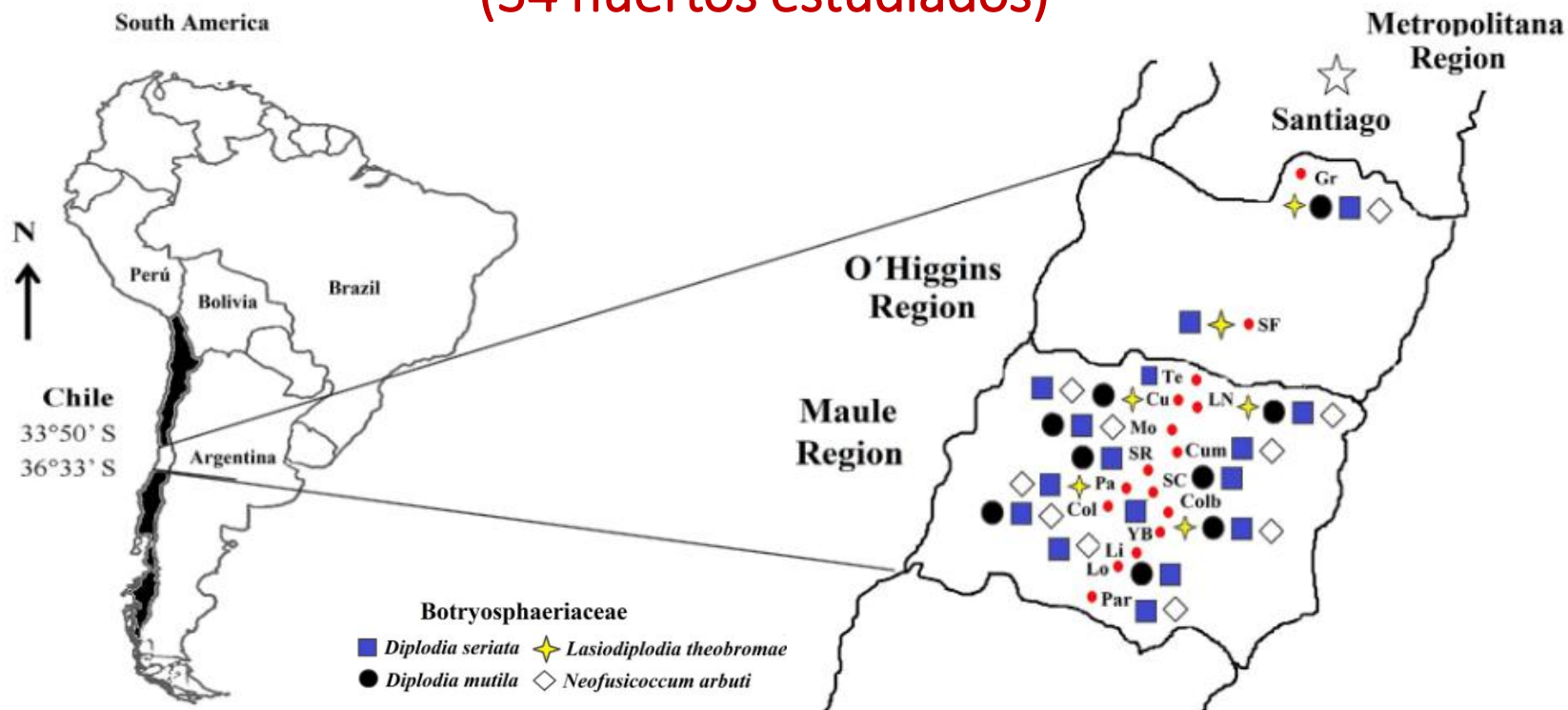
270 muestras
16 localidades
34 huertos



Entre 5 a 40%



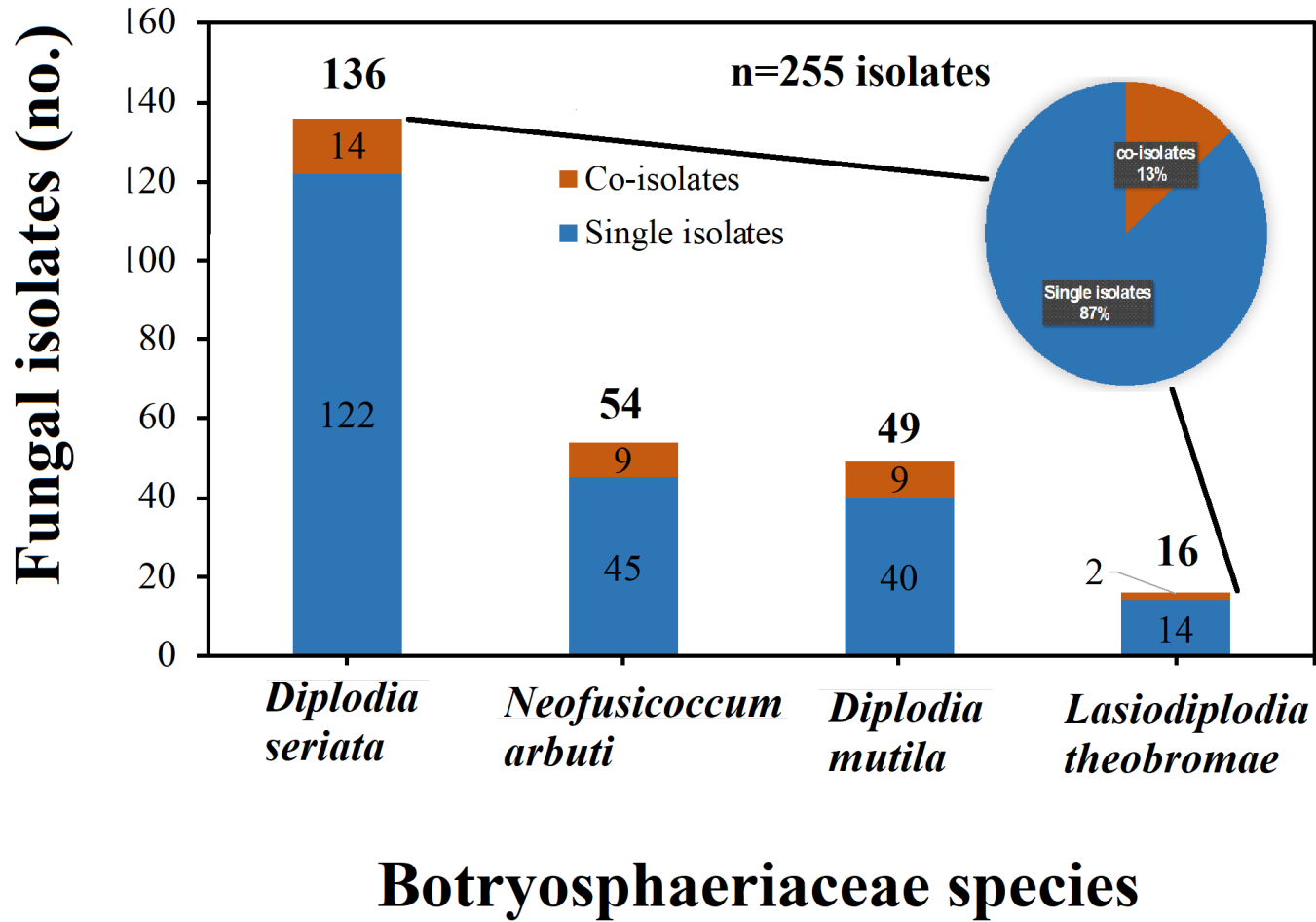
Distribución de Botryosphaeriaceae (34 huertos estudiados)



270 muestras
16 localidades
34 huertos

Regional Capital	Annual average			
	Temperature (°C)			Rainfall (mm)
	Min	Mean	Max	
Valparaíso	11.2	14.0	17.8	372
Santiago	7.7	14.2	22.7	342
Rancagua	7.3	14.7	22.3	505
Talca	8.1	14.2	21.7	676

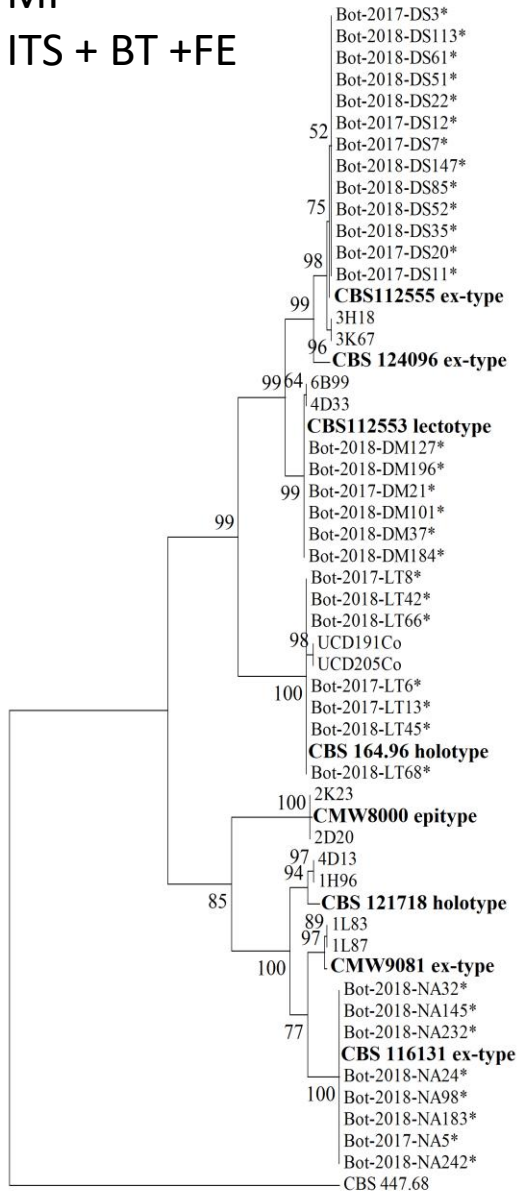
Frecuencia de Botryosphaeriaceae



Análisis filogenético

MP

ITS + BT + FE



Identificación: Cultural, morfológica y molecular

D. seriata Clade I **D-C**

D. pseudoseriata Clade II

D. mutila Clade III **A-C**

L. theobromae Clade IV **G-I**

B. dothidea Clade V

N. mediterraneum Clade VI

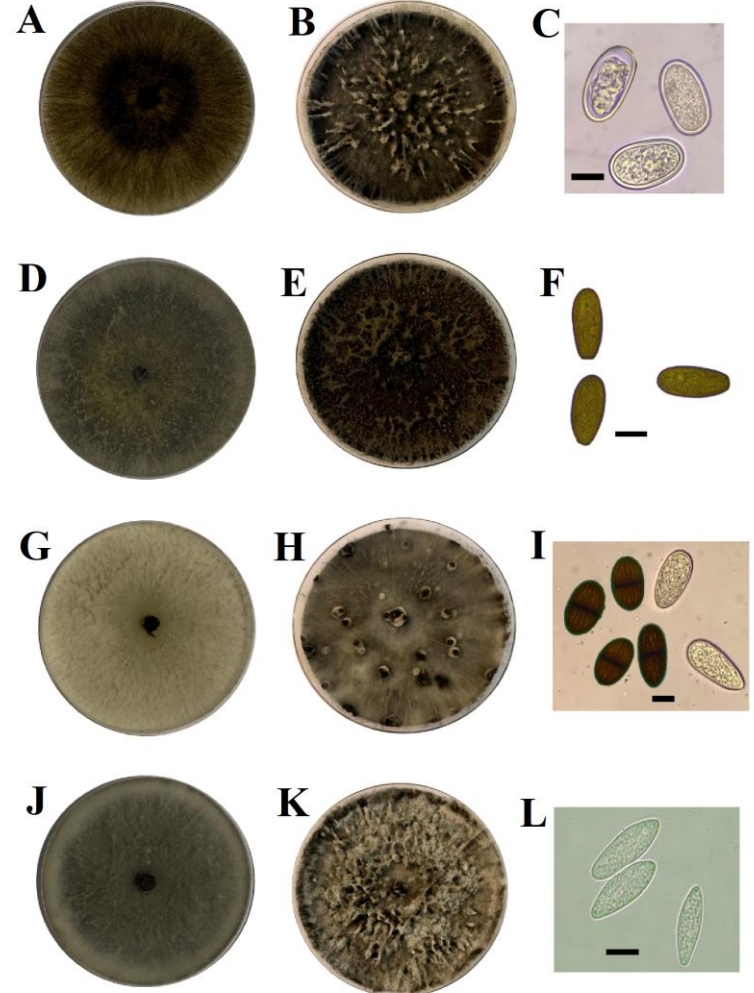
N. parvum Clade VII

N. arbuti Clade VIII **J-L**

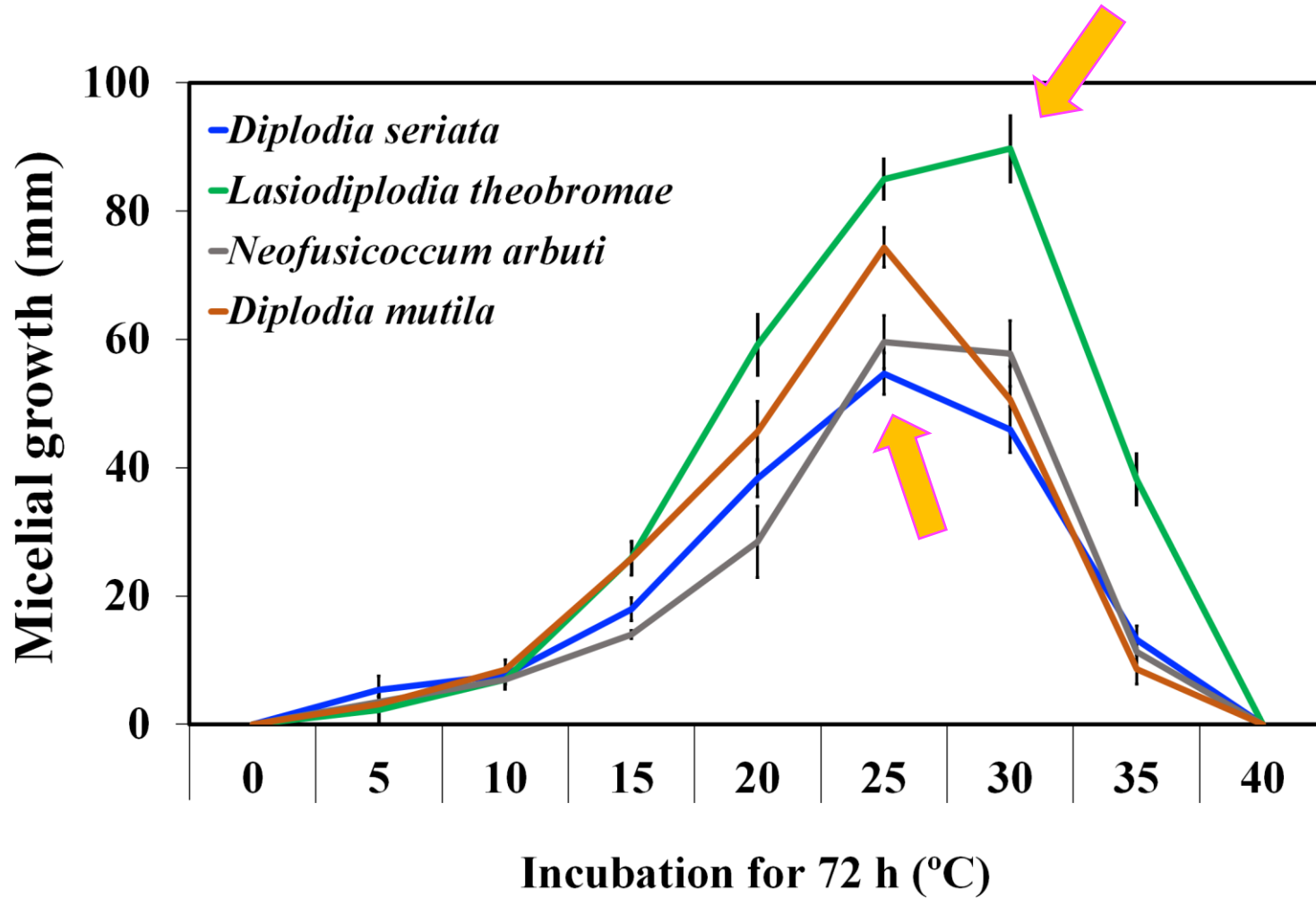
Guignardia philoprina

7 días

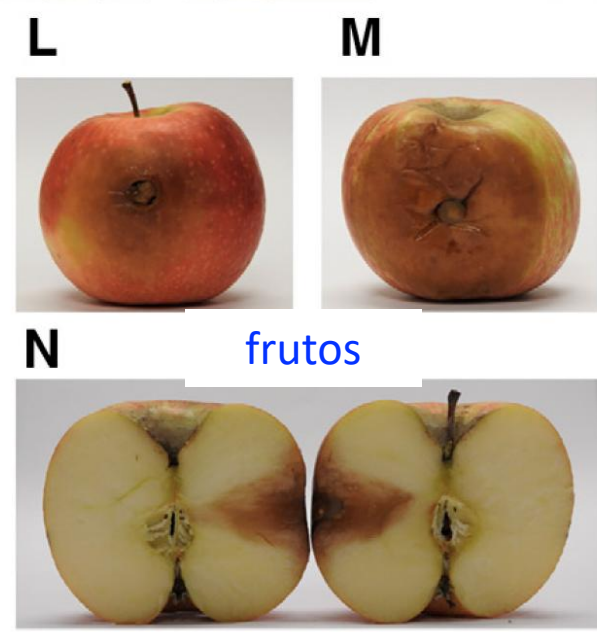
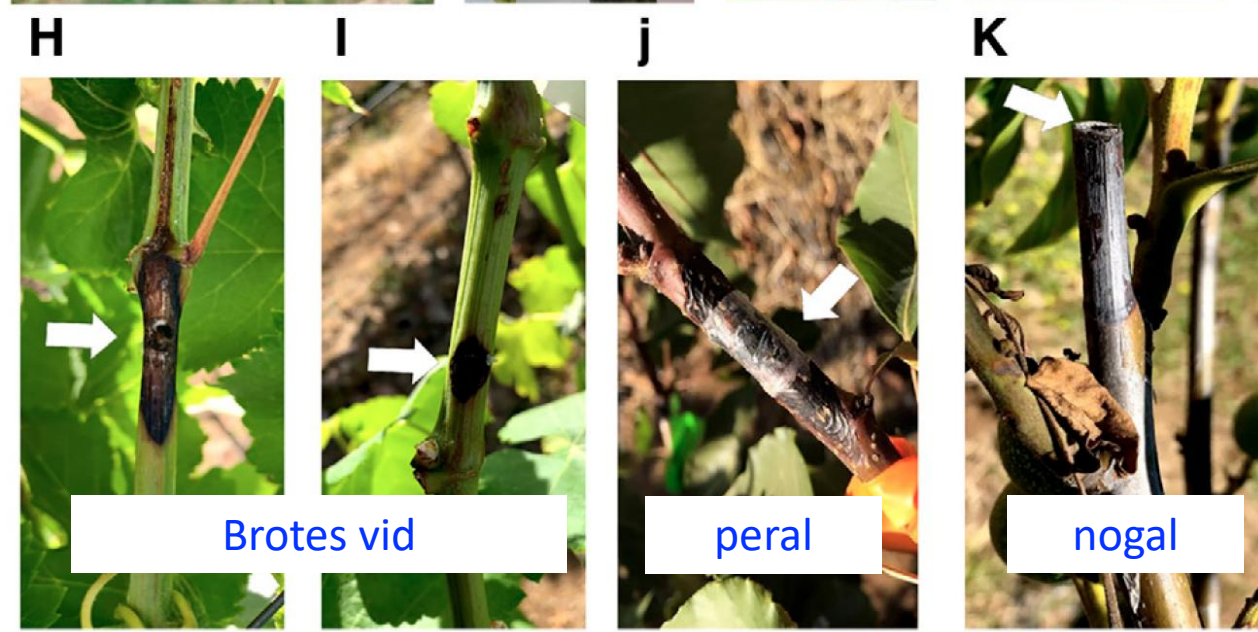
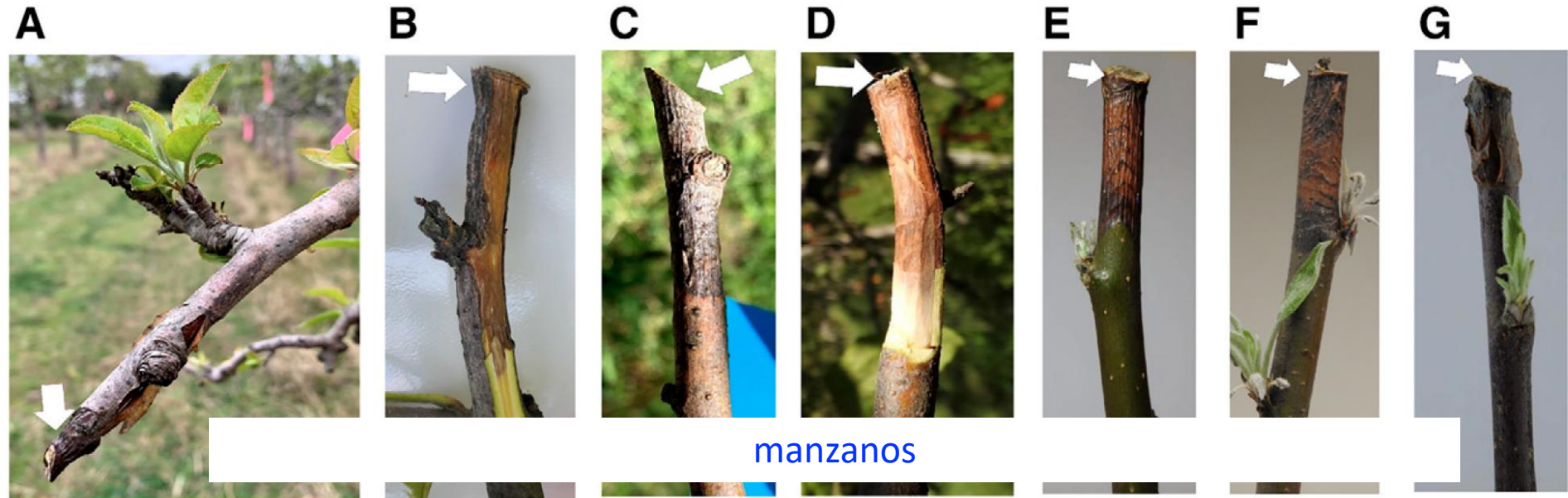
21 días



Curva de crecimiento



Lesiones en ramillas de manzanos, peras, nogales y brotes de vides en el campo



Resultados: Lesiones en frutos

D. seriata

L. theobromae

N. arbuti



- Después de 7 días de incubación a 20°C.
- Lesiones:
 - Cripps Pink (23 a 57 mm)
 - Promedio 35 mm
 - Fuji (24 a 61 mm);
 - Promedio 48 mm

Virulencia en frutos

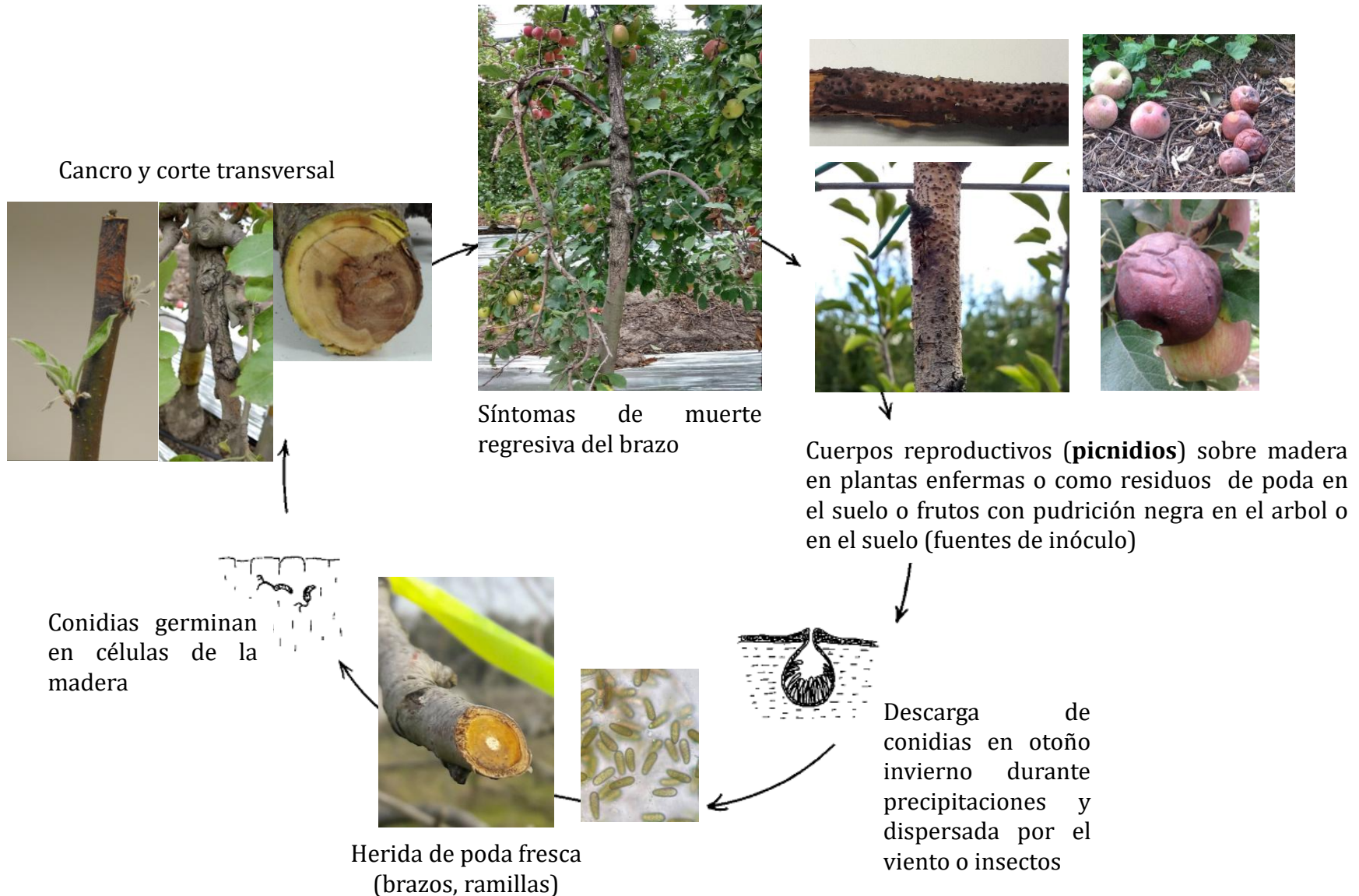
L. theobromae > *D. seriata* > *N. arbuti*

Lesiones en frutos de manzanos (8 variedades)

Diameter of lesion on mature apple fruit cultivars (mm)^x

Species/isolate	Fuji	Granny Smith	Braeburn	Cripps Pink	Modi	Scarlett	Red Chief	Gala	Mean
<i>Diplodia mutila</i>									
Bot-2017-DM2	26.0 b-h	15.9 b-f	8.2 b-f	13.0 b-f	16.0 b-f	13.0 b-f	8.8 b-f	4.7 b-d	13.2
Bot-2018-DM184	40.3 e-i	17.7 b-g	21.3 b-h	14.0 b-f	9.1 b-f	17.5 b-g	12.4 b-f	2.2 b-d	16.8
<i>Diplodia seriata</i>									
MZ-F1 ^y	32.7 b-i	18.2 b-f	17.6 b-g	18.4 b-g	8.7 b-f	5.8 b-d	4.0 b-d	3.9 b-d	16.7
Bot-2017-DS3	40.5 f-i	21.0 b-h	22.9 b-h	24.4 b-h	22.9 b-h	10.4 b-f	4.8 b-d	9.6 b-f	19.5
Bot-2018-DS22	31.5 b-i	36.7 d-i	21.2 b-h	10.6 b-f	9.3 b-f	3.3 b-d	5.1 b-d	10.8 b-f	16.1
Bot-2018-DS52	24.8 b-h	19.4 b-h	4.3 b-d	10.0 b-f	17.8 b-g	2.3 b-d	4.2 b-d	5.2 b-d	11.0
Bot-2018-DS85	45.7 e-i	26.5 b-h	9.7 b-f	12.5 b-f	7.9 b-f	5.8 b-e	15.8 b-f	4.0 b-d	15.8
Bot-2018-DS147	53.5 h-i	32.5 b-i	26.7 b-h	25.7 b-h	10.1 b-f	16.8 b-g	6.5 b-f	2.8 b-d	21.8
<i>Lasiodiplodia theobromae</i>									
Bot-2017-LT6	62.8 i	34.6 b-j	20.1 b-h	20.3 b-h	16.6 b-g	4.9 b-d	7.8 b-f	8.1 b-f	21.9
Bot-2018-LT45	50.1 g-i	29.2 b-i	36.0 c-i	25.6 b-h	16.5 b-g	21.4 b-h	10.9 b-f	6.8 b-f	24.6
<i>Neofusicoccum arbuti</i>									
Bot-2017-NA5	21.1 b-h	24.2 b-h	33.9 b-i	23.1 b-h	7.8 b-f	14.9 b-f	6.8 b-f	10.5 b-f	17.8
Bot-2018-NA32	8.0 b-f	23.0 b-h	9.0 b-g	14.1 b-f	8.6 b-f	12.7 b-f	4.3 b-d	6.8 b-f	10.8
Control ^z	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0
Mean	33.6	23.1	17.8	16.3	11.6	9.1	6.7	5.8	–
	df	P							
Isolate (A)	12	0.00001							
Cultivar (C)	7	0.00001							
Interaction A × C	84	0.0001							

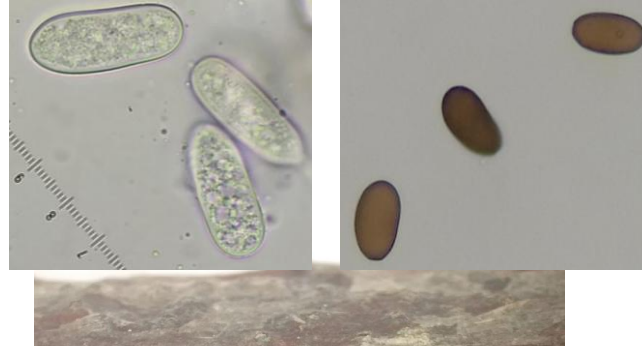
Ciclo muerte regresiva de brazos



Potenciales fuentes de inóculo

Fuente de inóculo:

Residuos de poda



N=100 residuos de poda
24% de aislamientos positivos al hongo *D. seriata*, *D. mutila* y Lasiodiplodia.



Antecedentes nacionales

'Botryosphaeriaceae en manzanas'

Pudrición negra de la manzana (Black rot)

- *Diplodia seriata* y *D. mutila*
- Precosecha-Cultivares tardíos-alta prevalencia (5-15%)

Pudrición blanda de la pulpa cv. Fuji



Precosecha-cosecha:
Manzanas cv. Fuji



Pudrición negra (black rot)

Síntomas



Síntomas severos: Bolsas de manzanas cv. Fuji

Fuente de inóculo:
Malezas ??



Las malezas han sido negativas para Botryosphaeriaceae
(malva, correhuela, siete venas, ballica entre otras)

Fuente de inóculo: Otros hospederos

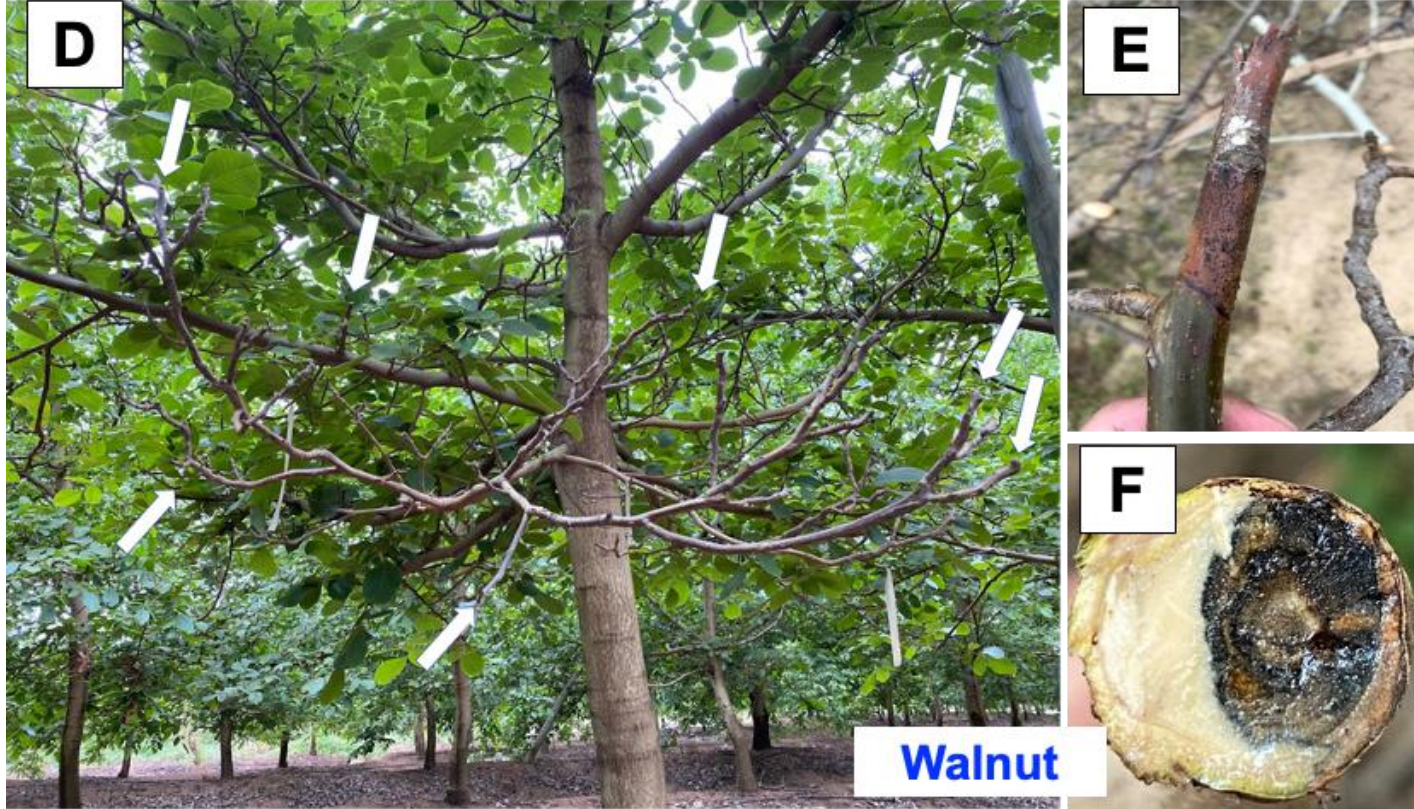
Cancrosis y muerte regresiva en kiwis



N= 250 muestras brazos
V, RM, VI, VII
Prevalencia de 5-75%

Neofusicoccum parvum y *Diplodia seriata*.
Especies frecuentes (26%) y más virulentas en kiwis.

Muerte regresiva en nogales



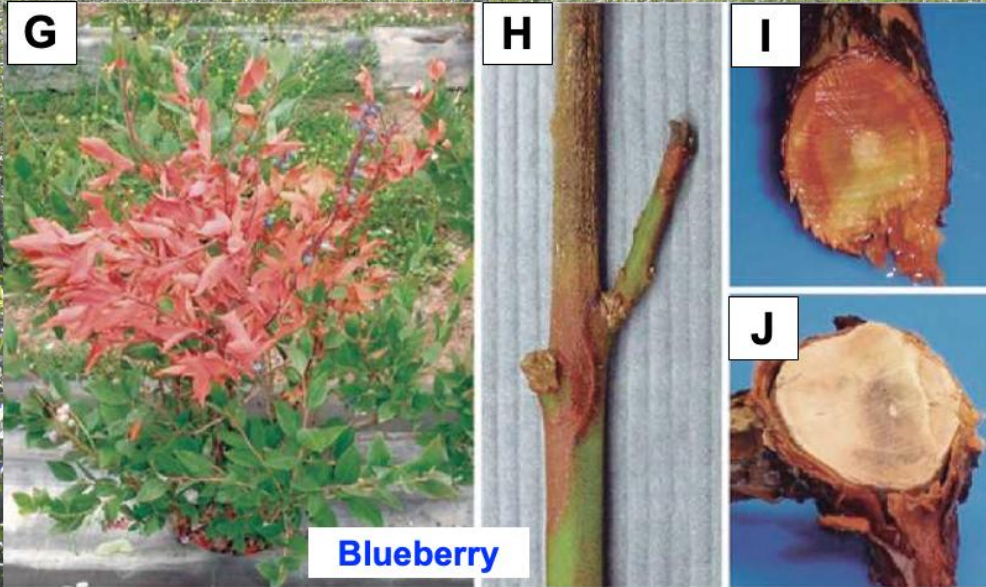
Especies identificadas

- *Diplodia mutila*
- *Dothiorella sarmentorum*
- *Neofusicoccum nonquaesitum*

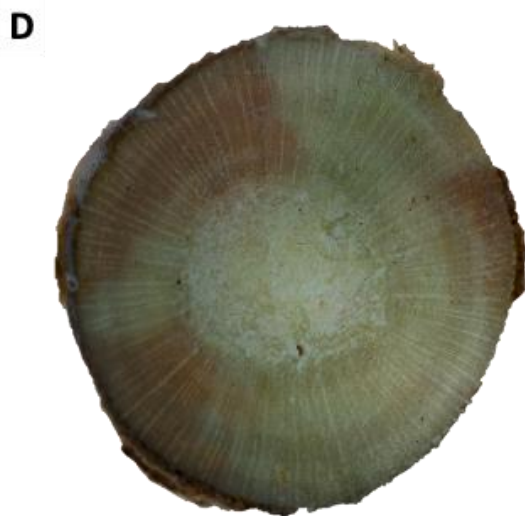
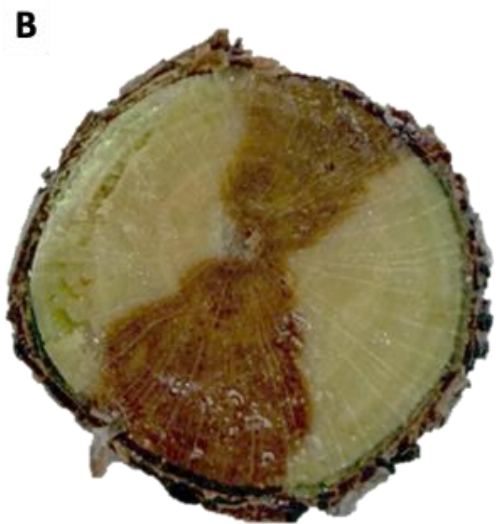
N= 120 muestras
Región del Maule.
Prevalencia de 3-65%

Fuente de inóculo:
Otros hospederos

Arándanos
Muerte regresiva



Neofusicoccum parvum, *N. arbuti* y *N. australe*
N. parvum la especie más virulenta en arándanos.



Muerte regresiva en Avellano europeo cv. Tonda Di Diffoni

DISEASE NOTE



Occurrence of *Neofusicoccum parvum* Causing Canker and Branch Dieback of European Hazelnut in Maule Region, Chile

Mauricio Lolas, Bernardo Latorre, Enrique Ferrada, Daina Grinbergs, Javier Chilian, Samuel Ortega-Farías, William Campillay-Llanos, and Gonzalo A. Díaz

Affiliations



- Prevalence, 10-36%, muerte regresiva
- *Neofusicoccum parvum*

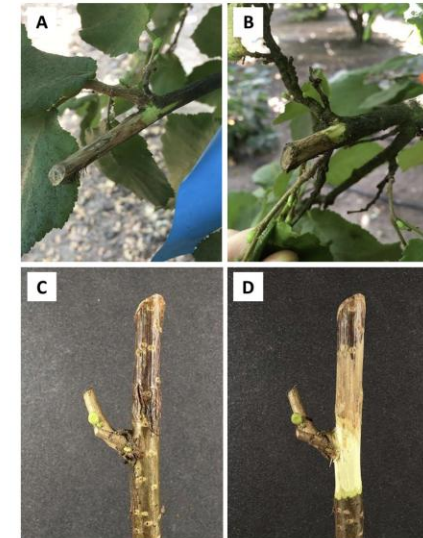
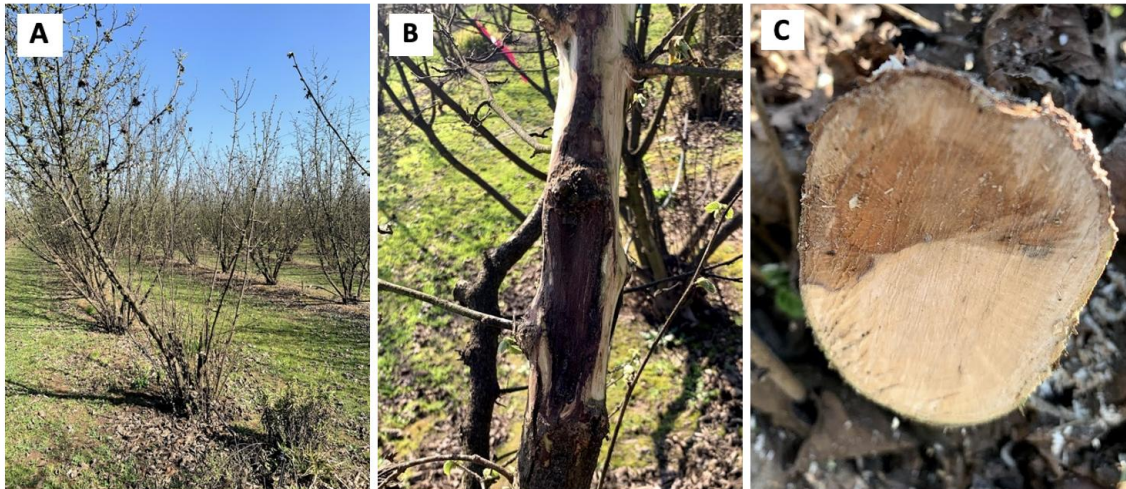
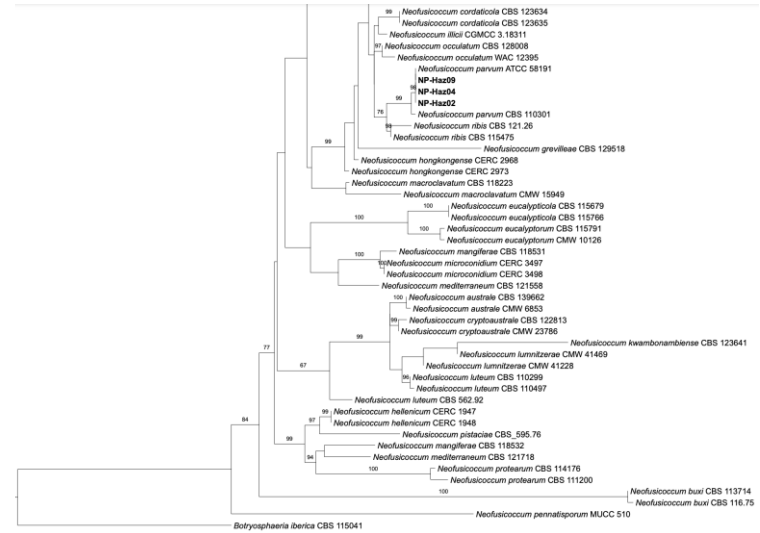


Figure 3. Pathogenicity studies performed on pruning wounds of attached branches of three-years-old (A and B) and one-year-old (C and D) in commercial orchard of hazelnut cv. Tonda Di Giffoni (8 years-old) in San Rafael, Maule Region, Chile.

¿Tienen la capacidad las
Botryosphaeriaceae de
infectar otros hospedero
frutal?

Lesiones en ramillas de manzanos, peras, nogales y brotes de vides en el campo (4 meses)

Mean lesion length (mm), (reisolation)^u

Species/isolate	Lignified twigs			Green shoots		
	Apple cvs. ^y		Pear cv. ^w	Walnut cv. ^x	Grapevine cvs. ^y	
	Fuji	Gala	Beurré Bosc	Chandler	Cabernet Sauvignon	Sauvignon Blanc
<i>Diplodia mutila</i> /Bot-2017-DM2	22.1 b (18)	15.2 b (20)	22.6 bc (15)	26.6 b (20)	38.4 c (20)	48.2 c (20)
<i>Diplodia seriata</i> /Bot-2017-DS3	31.3 c (18)	18.8 b (18)	27.3 c (20)	23.4 b (17)	19.1 b (20)	27.2 b (20)
<i>Lasiodiplodia theobromae</i> /Bot-2017-LT6	21.6 b (20)	18.2 b (19)	15.3 ab (15)	19.6 b (16)	16.2 ab (20)	19.1 ab (20)
<i>Neofusicoccum arbuti</i> /Bot-2018-NA32	72.1 d (20)	66.3 c (20)	48.1 d (20)	47.1 c (20)	23.4 b (19)	26.6 b (20)
Control ^z	8.9 a (0)	6.3 a (0)	8.3 a (0)	5.1 a (0)	6.8 a (0)	7.3 a (0)
df	4	4	4	4	4	4
F	243.2	135.8	69.8	32.9	26.8	32.6
P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Host



Apple

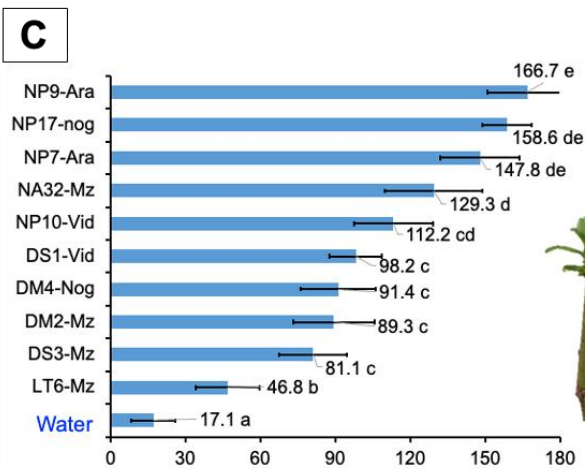
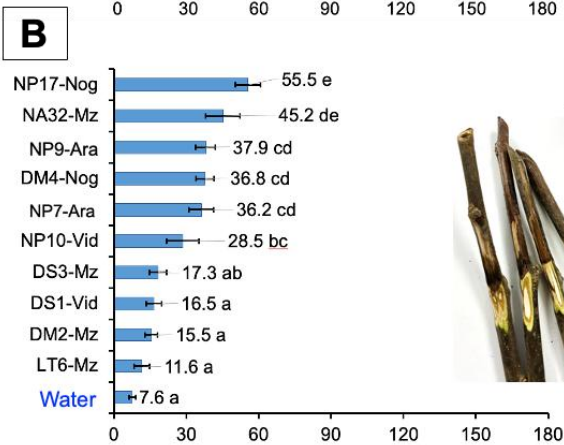
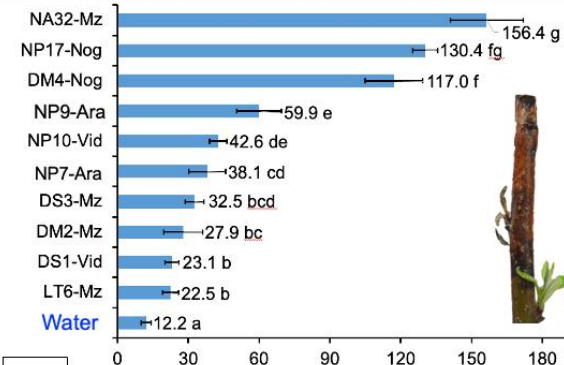


Walnut



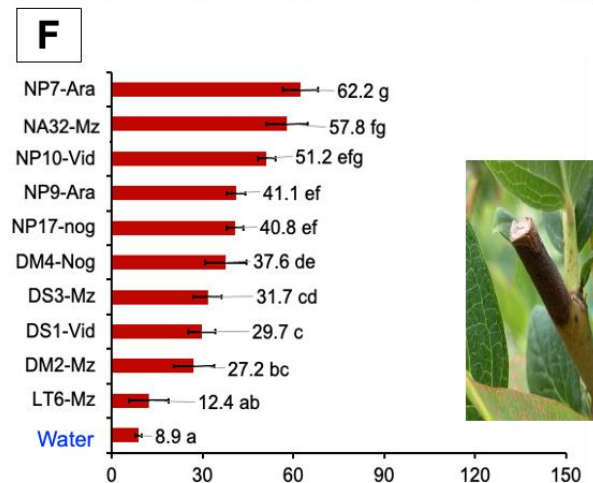
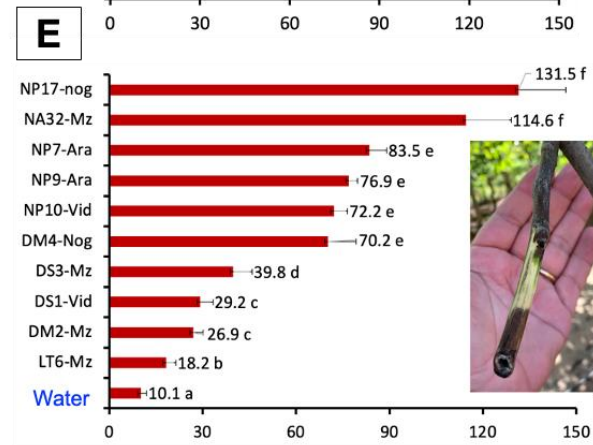
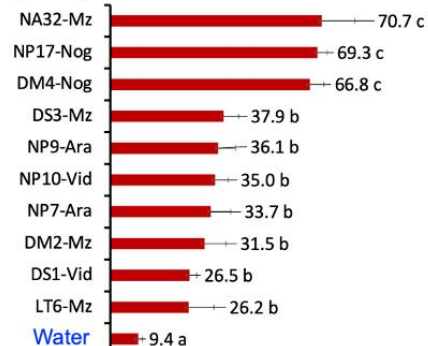
Blueberry

A Greenhouse



Necrotic lesion (mm, after 4 months)

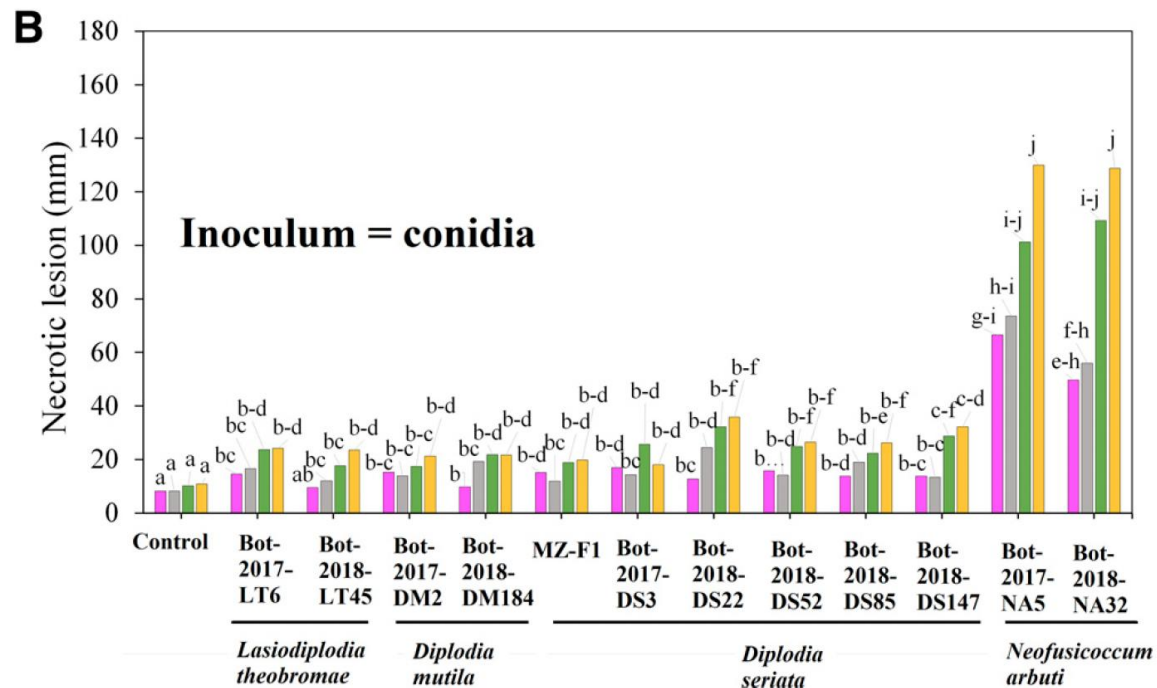
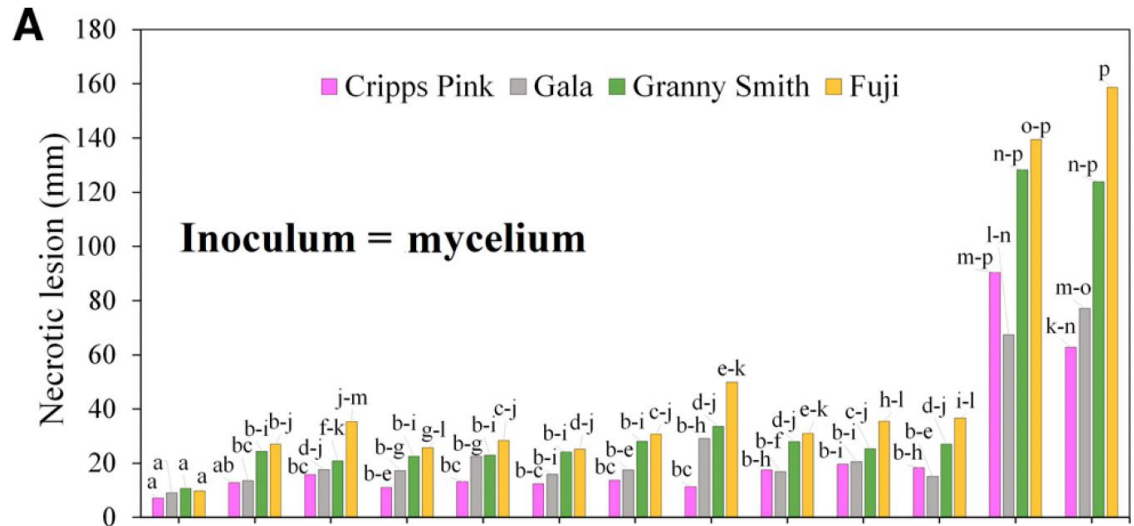
D Field



Necrotic lesion (mm, after 8 months)

¿Existe diferencia
varietal en
susceptibilidad a la
infección por
Botryosphaeriaceae?

Lesiones en ramillas de manzanos (3 meses)

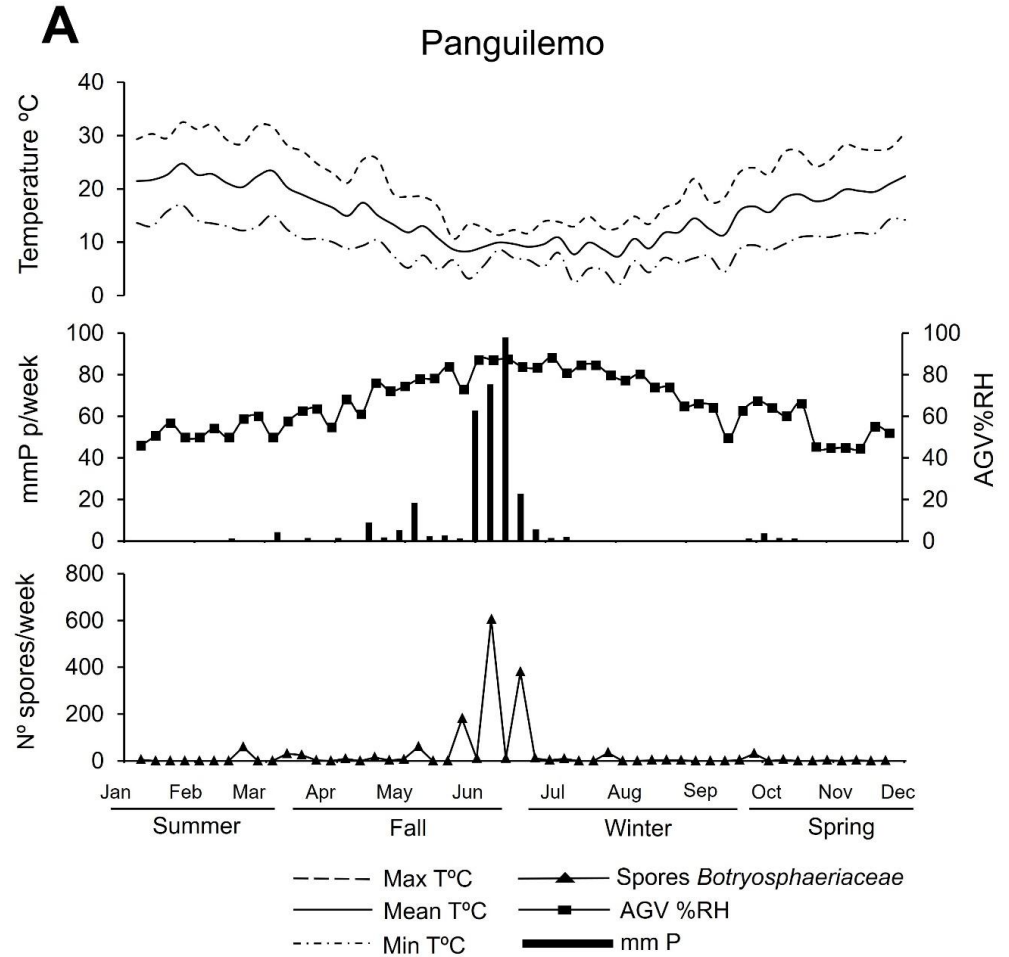
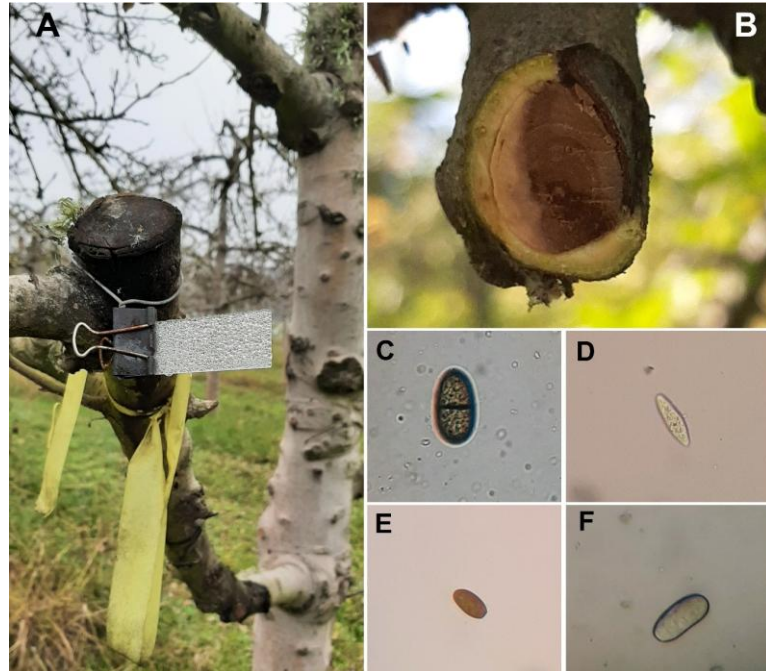


Liberación de conidias: Período crítico

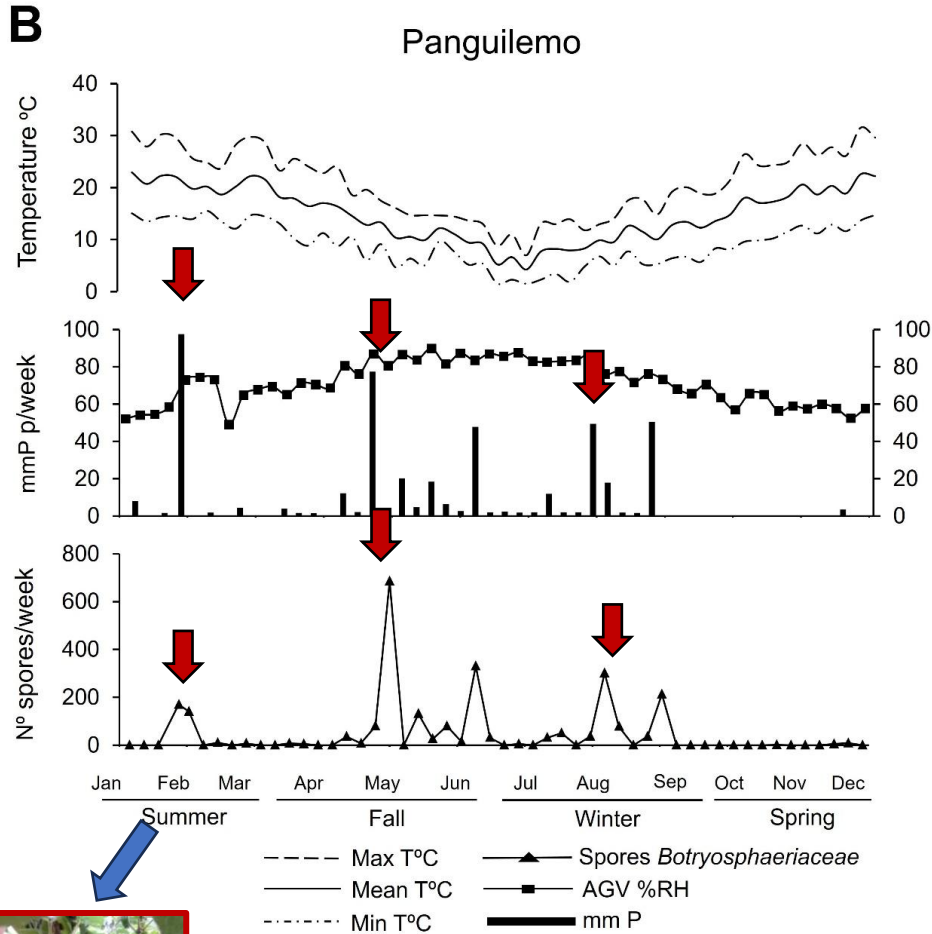


Estación experimental Panguilemo, Región del Maule
Cuartel de cv. Fuji

Liberación y dispersión de conidias

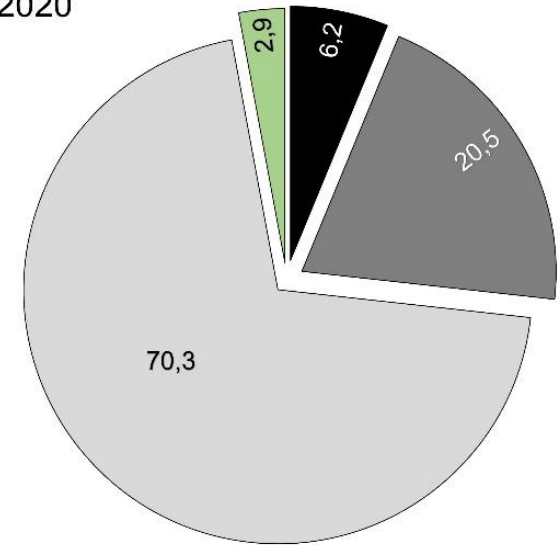


Liberación y dispersión de conidias



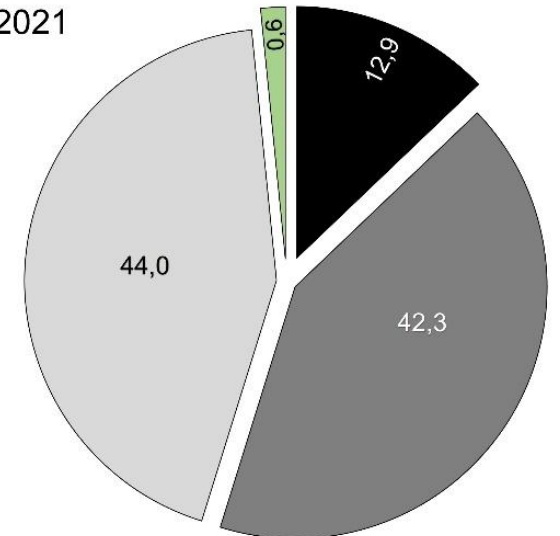
A

2020



B

2021



■ summer ■ fall □ winter ■ spring



Susceptibilidad de la
edad de la herida de
poda

Susceptibilidad de la edad de heridas de poda

A

cv. Gala



Edad de 1 día

cv. Fuji



B

cv. Gala



Edad de 15 días

cv. Fuji



C

cv. Gala



Edad de 30 días

cv. Fuji



D

cv. Gala



Edad de 45 días

cv. Fuji



Lt-R Ds-F Dm-W Na-W Ds-W Lt-W Control

Lt-R Ds-F Dm-W Na-W Ds-W Lt-W Control



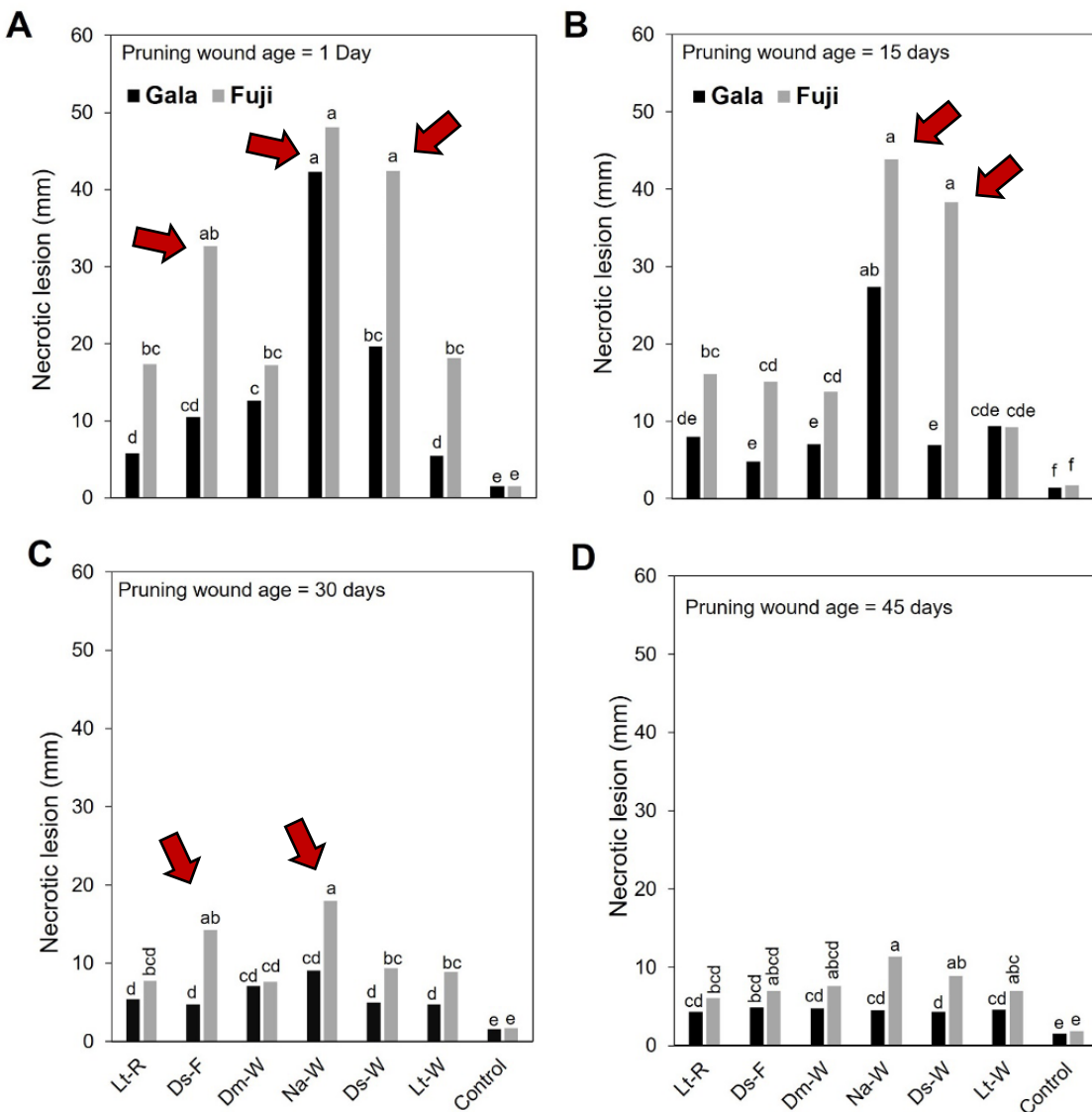
Aislado de madera (W)



Aislado de fruto (F)



Aislado de residuo (R)



Susceptibilidad de la edad de heridas de poda

Cultivares Fuji vs Gala

Neofusicoccum arbuti,
Diplodia seriata son más virulentos (lesiones necróticas)

Los primeros 15 días son altamente susceptibles vs 30-45 días en la edad de las heridas de poda.

Figure 2. Lesion length caused by *L. theobromae* (Lt-R; obtained from pruning residues), *D. seriata* (Ds-F; obtained from apples with black rot), and isolates obtained from wood (W) samples with apple dieback including to *D. mutila* (Dm-W), *N. arbuti* (Na-W), *D. seriata* (Ds-W) and *L. theobromae* (Lt-W) on pruning wound of ages of 1 days (A), 15 days (B), 30 days (C), and 45 days (D) after 6 months of incubation in the field at the Panguilemo experimental station (Universidad de Talca, Talca, Chile).

Efecto de la fecha de poda

Temprana: junio

Tardía: agosto

Table 2. Effect of pruning time based on early (June) and late (August) pruning of lignified twigs cvs. Fuji and Gala on lesion length (mm) caused by artificial inoculation using conidial suspension (40 μ L of 10^5 conidia/mL) of *Diplodia mutila* (isolate Dm-W), *D. seriata* (isolates Ds-F and Ds-W), *Lasiodiplodia theobromae* (isolates Lt-R and Lt-W) and *Neofusicoccum arbuti* (isolate Na-W) after six months at Pangulemo experimental station (Talca, Maule region, Central Chile).

Species of Botryosphaeriaceae /Isolate	Mean of lesion length (mm)					
	Pruning cv. Fuji ^a			Pruning cv. Gala ^a		
	Early	Late	Mean	Early	Late	Mean
<i>D. mutila</i> /Dm-W	32.3 cd	21.8 def	27.1	23.3 c	11.4 e	17.3
<i>D. seriata</i> /Ds-F	33.4 bc	22.8 de	28.1	18.3 d	10.3 ef	14.3
<i>D. seriata</i> /Ds-W	32.6 bcd	19.1 ef	25.8	23.8 c	13.0 de	18,4
<i>L. theobromae</i> /Lt-R	17.7 f	25.8 d	21.7	7.6 fg	10.5 ef	9,1
<i>L. theobromae</i> /Lt-W	18.5 ef	25.0 d	21.8	6.5 g	9.5 ef	8.0
<i>N. arbuti</i> /Na-W	64.4 a	40.4 b	52.4	57.1 a	35.0 b	46.1
Control ^b	3.9 g	3.5 g	3.7	3.4 h	3.3 h	3.4
Mean	29.0	22.6	25.8	19.9	13.3	16,6
ANOVA	df	P	SED^c	df	P	SED^c
Pruning time (P)	1	0.0004	3.41	1	0.0021	0.94
Isolate (I)	6	<0.0001	2.71	6	<0.0001	1.54
P x I	6	<0.0001	3.67	6	<0.0001	2.10

^a Mean lesion length followed by the same lower case letter in each column did not differ significantly according to LSD Fisher pairwise multiple comparison test (P =0.05).

^b Negative control treatment inoculated using 40 μ L of sterile distilled water on wounded twigs of apple trees.

^cSED: Standard error of the difference was calculated by standard error of the mean $\times \sqrt{2}$.

Sensibilidad *in vitro*

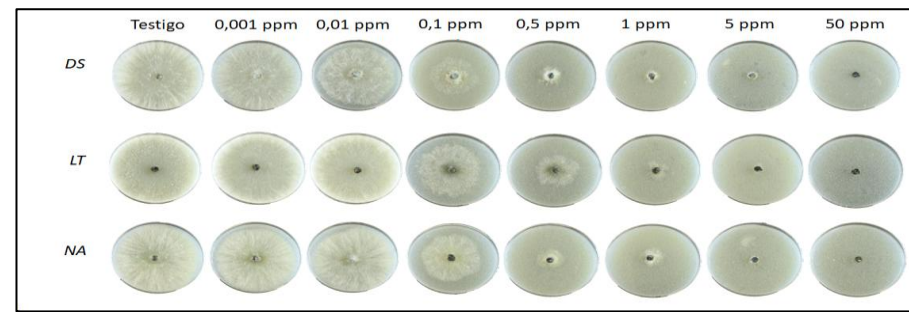


Table 2. In vitro sensitivity (EC_{50}) of *Diplodia mutila* (isolate Dm-W), *D. seriata* (isolate Ds-W), *Lasiodiplodia theobromae* (isolate Lt-W), and *Neofusicoccum arbuti* (isolate Na-W) to 12 chemical fungicides registered for use in fruit trees in Chile

Active ingredient ^u	Fungicide group ^v	Mean EC_{50} values ($\mu\text{g/ml}$) for inhibition of mycelial growth of <i>Botryosphaeriaceae</i> spp. ^w					Mean ^x
		<i>D. mutila</i>	<i>D. seriata</i>	<i>L. theobromae</i>	<i>N. arbuti</i>		
Benomyl	BMC	0.03	0.08	0.03	0.17	0.08 a	
Boscalid	SDHI	71.95	93.65	115.84	61.85	85.82 c	
Captan	Phthalimides	29.00	45.95	40.40	52.5	41.96 b	
Difenoconazole	DMI	0.04	0.012	0.37	0.06	0.12 a	
Fluazinam	Dinitroanilines	0.04	0.14	0.12	0.08	0.09 a	
Tebuconazole	DMI	0.08	0.12	0.26	0.26	0.18 a	
Thiophanate-methyl	BMC	0.35	0.73	0.53	1.23	0.71 a	
Fluxapyroxad + pyraclostrobin	SDHI + QoI	0.55	0.77	1.58	0.26	0.79 a	
Thiophanate-methyl + tetraconazole	BMC + DMI	0.24	1.21	2.33	0.46	1.06 a	
Azoxystrobin + difenoconazole	QoI + DMI	2.62	1.73	18.14	1.33	5.95 ab	
Boscalid + pyraclostrobin	SDHI + QoI	0.74	0.73	10.12	0.24	2.96 ab	
Azoxystrobin + propiconazole + pydiflumetofen	QoI + DMI + SDHI	8.11	0.26	1.92	0.25	0.63 a	
Mean ^y	–	8.81	12.11	15.97	9.89	11.70	
ANOVA	df	<i>P</i>	SED ^z	–	–	–	
Species (S)	3	0.7371	6.85	–	–	–	
Fungicide (F)	11	<0.0001	11.87	–	–	–	
S × F	33	>0.9999	23.74	–	–	–	

Protección de estacas

Table 3. Necrotic lesion severity (lesion length, mm) and reduction of severity (%) of protected pruning wounds with chemical fungicides against infection by Botryosphaeriaceae spp. on 1-year-old cuttings of apple cultivar Fuji under greenhouse conditions after 120 days

Table 4. Necrotic lesion severity (lesion length, mm) and reduction of severity (%) of pruning wound protected with chemical fungicides against infection by Botryosphaeriaceae spp. on twigs (2 years old) of the apple cultivar Fuji in the field after 180 days

Active ingredient	Active ingredient	Target disease (host) ^y	Botryosphaeriaceae spp. infection on protected pruning wounds ^w								SR (%) ^y
			<i>D. mutila</i>		<i>D. seriata</i>		<i>L. theobromae</i>		<i>N. arbuti</i>		
			Severity (mm) ^x	SR (%) ^y	Severity (mm) ^x	SR (%) ^y	Severity (mm) ^x	SR (%) ^y	Severity (mm) ^x	SR (%) ^y	
Benomyl	Benomyl	European canker (apple)	10.6 a	76.1	13.0 ab	66.4	13.2 a	67.6	12.8 ab	70.6	5.3
Captan	Captan	Canker and dieback (apple)	32.5 de	26.5	30.2 cd	22.0	27.2 cd	33.0	33.4 cd	23.5	5.8
Fluazina	Fluazinam	Scab (apple)	27.1 cd	38.7	23.3 cd	39.9	20.4 ab	49.7	25.8 cd	40.9	5.6
Tebucon	Tebuconazole	Scab (apple)	14.4 ab	67.5	12.5 ab	67.6	21.5 a	47.1	16.3 ab	62.7	4.7
Thiophar	Thiophanate-methyl	Powdery mildew (apple)	14.0 ab	68.4	11.8 ab	69.5	11.9 a	70.7	12.1 ab	72.4	5.3
Boscalid	Boscalid + pyraclostrobin	Gray mold (grapevine)	16.3 bc	63.3	19.5 bc	49.6	21.6 bc	46.7	22.6 bc	48.2	5.3
Fluxapyr	Fluxapyroxad + pyraclostrobin	Dieback (walnut)	20.5 bc	53.7	16.78 abc	56.7	18.5 ab	54.5	19.5 ab	55.4	5.1
Thiophar	Thiophanate-methyl + tetraconazole	Scab (apple)	11.6 a	73.7	14.2 a	63.2	11.7 a	71.0	12.9 a	70.5	5.1
Control	Control	–	44.2 e	–	38.7 d	–	40.6 d	–	43.7 d	–	–
ANOVA	ANOVA		<i>P</i>	SED ^z	<i>P</i>	SED ^z	<i>P</i>	SED ^z	<i>P</i>	SED ^z	SED ^z
			<0.0001	3.18	<0.0001	4.95	<0.0001	2.82	<0.0001	4.64	2.36

^y Target disease: Fungicide registered by manufacturers in Chile.

Protección de ramillas (dos años)

Table 4. Necrotic lesion severity (lesion length, mm) and reduction of severity (%) of pruning wound protected with chemical fungicides against infection by Botryosphaeriaceae spp. on twigs (2 years old) of the apple cultivar Fuji in the field after 180 days

Active ingredient	Target disease (host) ^v	Botryosphaeriaceae spp. infection on protected pruning wounds ^w							
		<i>D. mutila</i>		<i>D. seriata</i>		<i>L. theobromae</i>		<i>N. arbuti</i>	
		Severity (mm) ^x	SR (%) ^y	Severity (mm) ^x	SR (%) ^y	Severity (mm) ^x	SR (%) ^y	Severity (mm) ^x	SR (%) ^y
Benomyl	European canker (apple)	10.6 a	76.1	13.0 ab	66.4	13.2 a	67.6	12.8 ab	70.6
Captan	Canker and dieback (apple)	32.5 de	26.5	30.2 cd	22.0	27.2 cd	33.0	33.4 cd	23.5
Fluazinam	Scab (apple)	27.1 cd	38.7	23.3 cd	39.9	20.4 ab	49.7	25.8 cd	40.9
Tebuconazole	Scab (apple)	14.4 ab	67.5	12.5 ab	67.6	21.5 a	47.1	16.3 ab	62.7
Thiophanate-methyl	Powdery mildew (apple)	14.0 ab	68.4	11.8 ab	69.5	11.9 a	70.7	12.1 ab	72.4
Boscalid + pyraclostrobin	Gray mold (grapevine)	16.3 bc	63.3	19.5 bc	49.6	21.6 bc	46.7	22.6 bc	48.2
Fluxapyroxad + pyraclostrobin	Dieback (walnut)	20.5 bc	53.7	16.78 abc	56.7	18.5 ab	54.5	19.5 ab	55.4
Thiophanate-methyl + tetraconazole	Scab (apple)	11.6 a	73.7	14.2 a	63.2	11.7 a	71.0	12.9 a	70.5
Control	–	44.2 e	–	38.7 d	–	40.6 d		43.7 d	
ANOVA		<i>P</i>	SED ^z	<i>P</i>	SED ^z	<i>P</i>	SED ^z	<i>P</i>	SED ^z
		<0.0001	3.18	<0.0001	4.95	<0.0001	2.82	<0.0001	4.64

^v Target disease: Fungicide registered by manufacturers in Chile.





Agradecimientos

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