

# Antoferine<sup>®</sup>

the natural biosolution inhibiting  
fungal growth and mycotoxin production

A plant-based innovation for safer crops  
and sustainable agriculture



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# Agricultural losses : mycotoxinogenic molds and Pest management

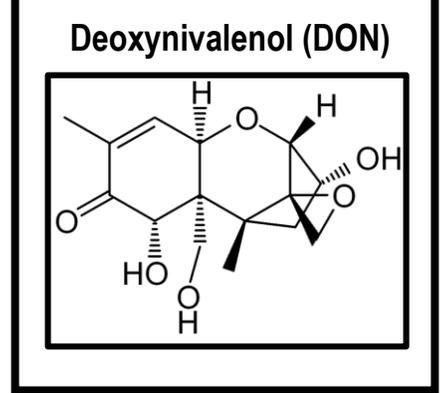
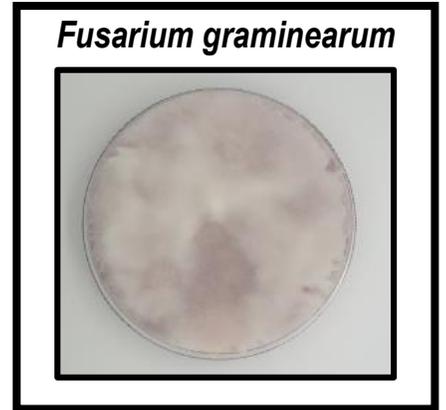
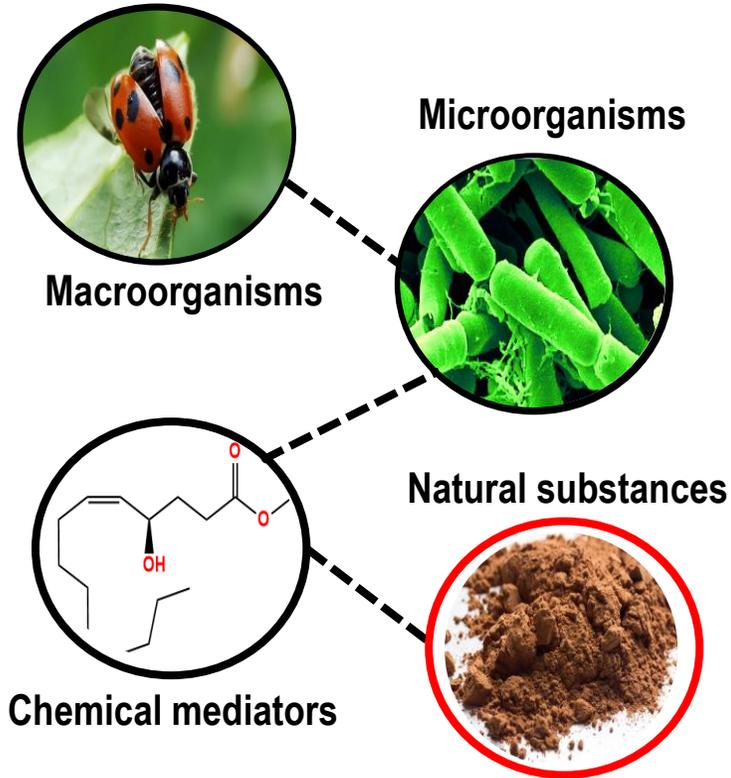


**Table 3.** Worldwide contamination by aflatoxins observed in foods.

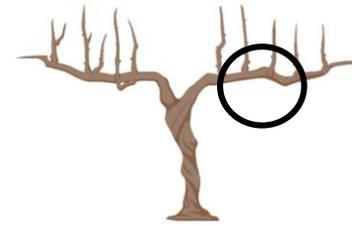
Country	Food commodity	Levels (range)
China	Corn	9-2496 µg/kg
	Rice	0.99-3.87 µg/kg
Irish	Spices	18.5-27.5 µg/kg
Italy	Spices	0.57-26.9 µg/kg
Japan	Peanut butter	2.59 µg/kg
United States	Maize	21-699 µg/kg

**Table 6.** Worldwide contamination by deoxynivalenol observed in foods.

Country	Food commodity	Levels (range mg/kg)
China	Raw corn	<0.5-2.7
	Cornmeal	<0.5-1.6
China	Wheat	0.016-51.45
	Barley	0.132-3.521
	Corn	0.256-21.2
United States	Durum wheat	0.0-23.0
	Hard winter wheat	0.8-7.6
	Soft winter wheat	1.4-14.6
	Hard spring wheat	3.7-18.4
	Soft white wheat	0.1-0.7



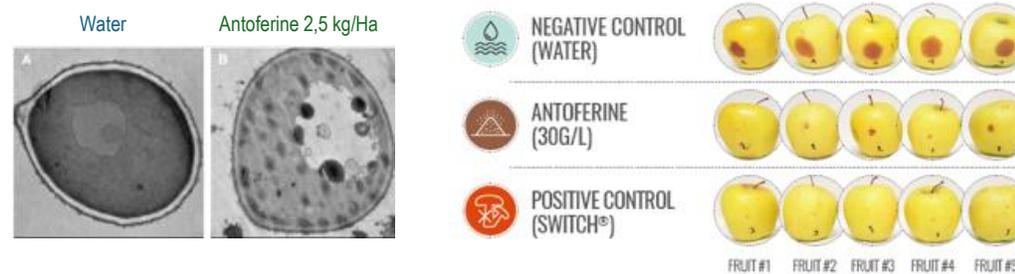
# Natural plant extract rich in phenolic compounds : Antoferine®



- 787,000 ha (2018) of vines planted in France
- Total annual volume estimated to 8.4 million metric tones

Active substance : Antoferine®

Patent : FR3061176A1, 2016\*



## IN VITRO TEST

- > 20 FUNGI TESTED

## IN VIVO TEST

- > 10 PHYTOPATHOSYSTEM STUDIED

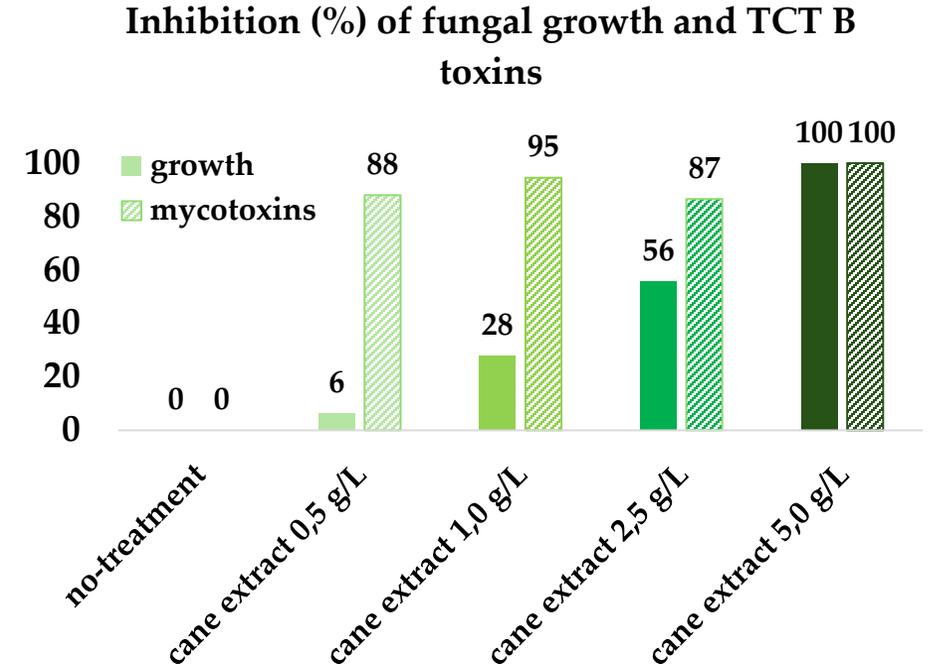
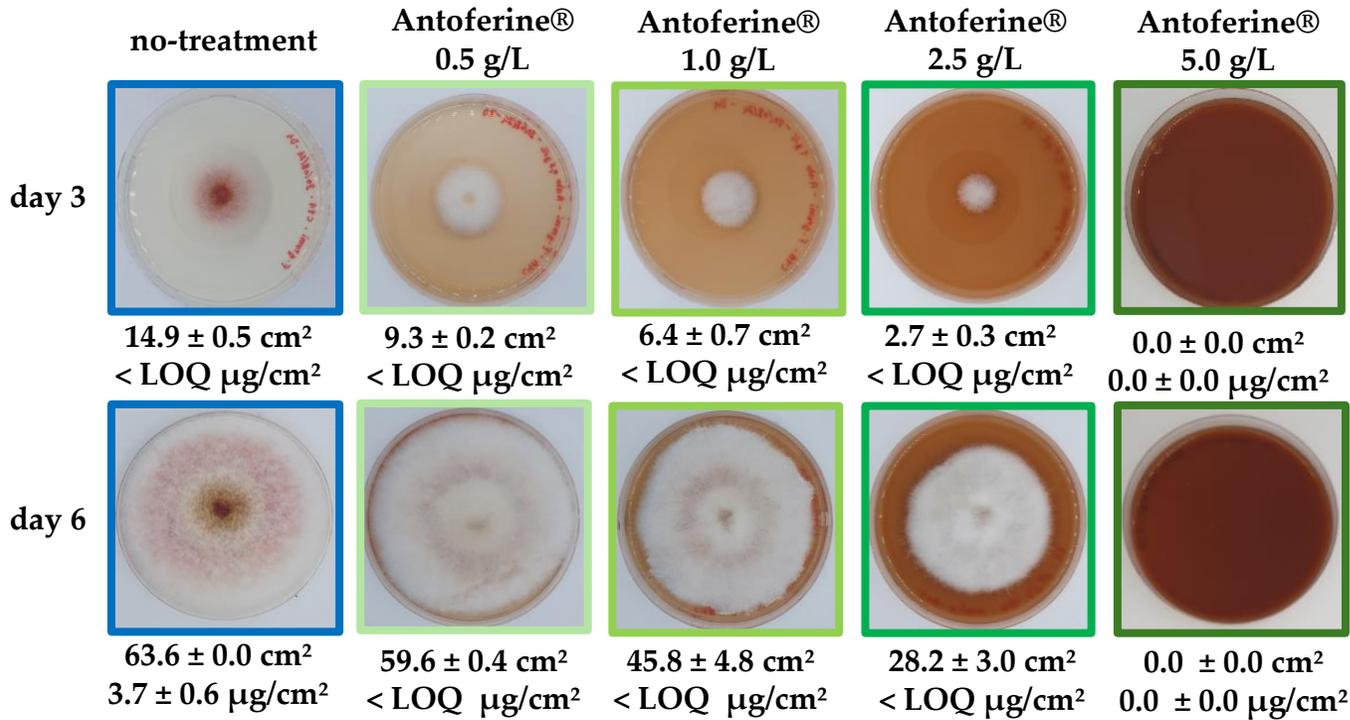
## On fields TEST

- > 150 FIELD TRIALS IN EUROPE



- Homologation CE 1107/2009 → DAR validated
- EFSA evaluation on going
- Representative use : APPLE SCAB / *Venturia inaequalis*
- AMM in EU : 2029

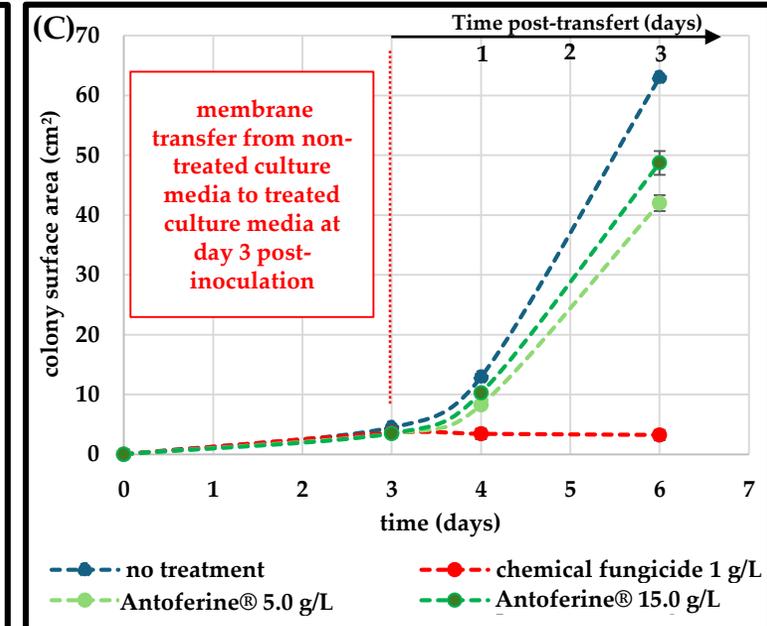
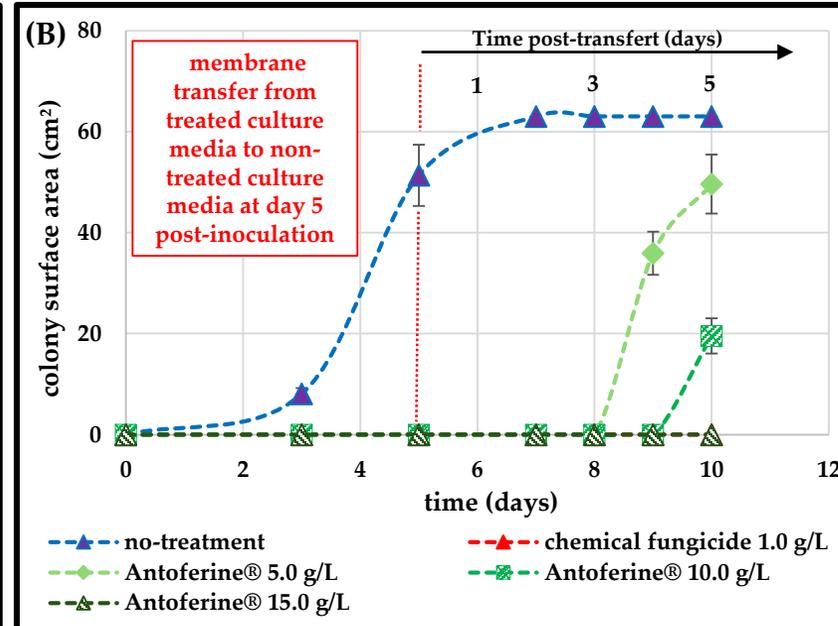
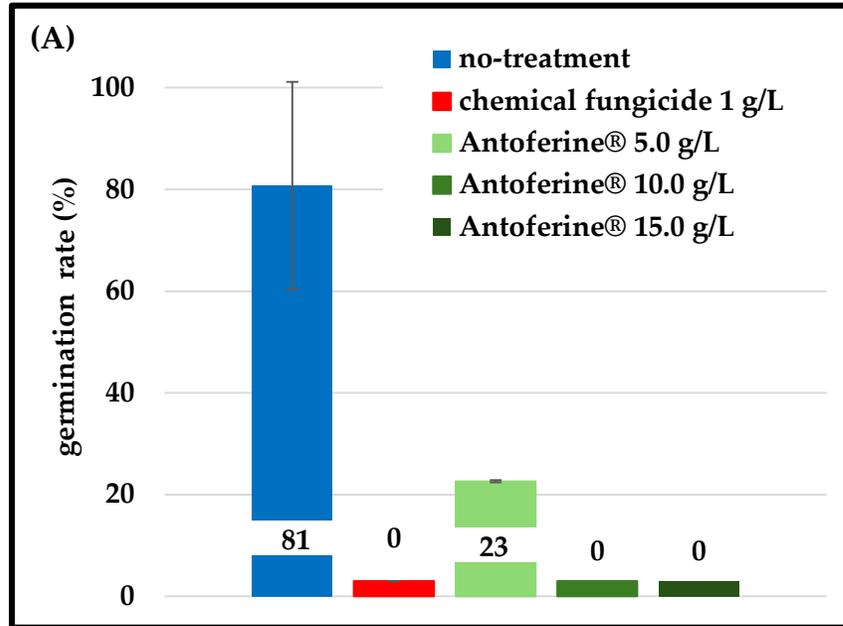
# Antoferine® as a Growth and Toxin Inhibitor of *F. graminearum*



- **Dose-dependent inhibition** of the fungal growth
- Visible shift from red to white mycelia observed at day 6 in presence of extract
  - **Low concentration** of extract induce a delay in growth while **higher concentration** fully suppressed fungal development

- No correlation between inhibition of growth and inhibition of toxins
- **Inhibition of TCT B** require much **lower concentration** of extract than inhibition of growth
- In presence of cane extract DON was systematically below < LOQ = 0.9 μg/cm<sup>2</sup>

# F. graminearum : An Early-Stage Sensitive Fungi: Germination Inhibition and Remanence of Antifungal Effect



Quantification of *F. graminearum* DON in culture media at day 10

conditions	no-treatment	Antoferine® 5.0 g/L	Antoferine® 10.0 g/L
specific production ( $\mu\text{g}/\text{cm}^2$ )	$5.2 \pm 0.7$	< LOQ	< LOQ

Quantification of *F. graminearum* DON in culture media at day 6

conditions	no-treatment	Antoferine® 5.0 g/L	Antoferine® 15.0 g/L
specific production ( $\mu\text{g}/\text{cm}^2$ )	$2.1 \pm 0.4$	< LOQ	< LOQ

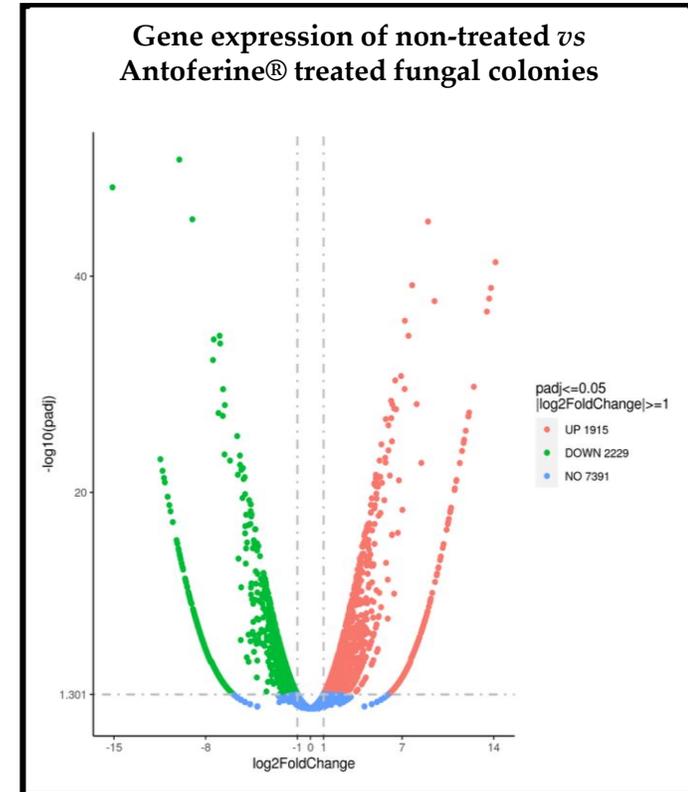
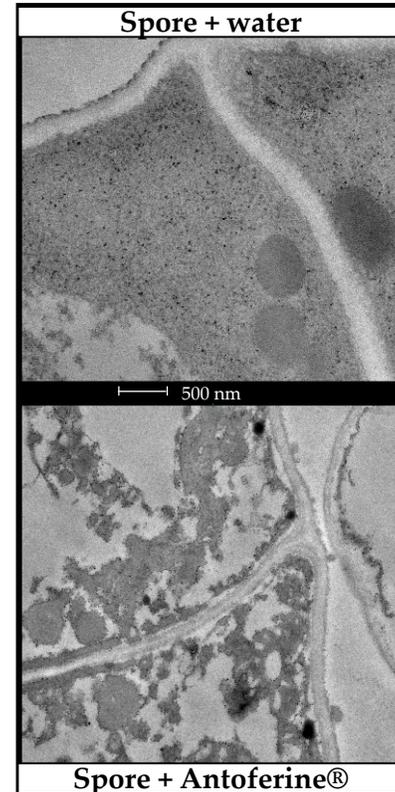
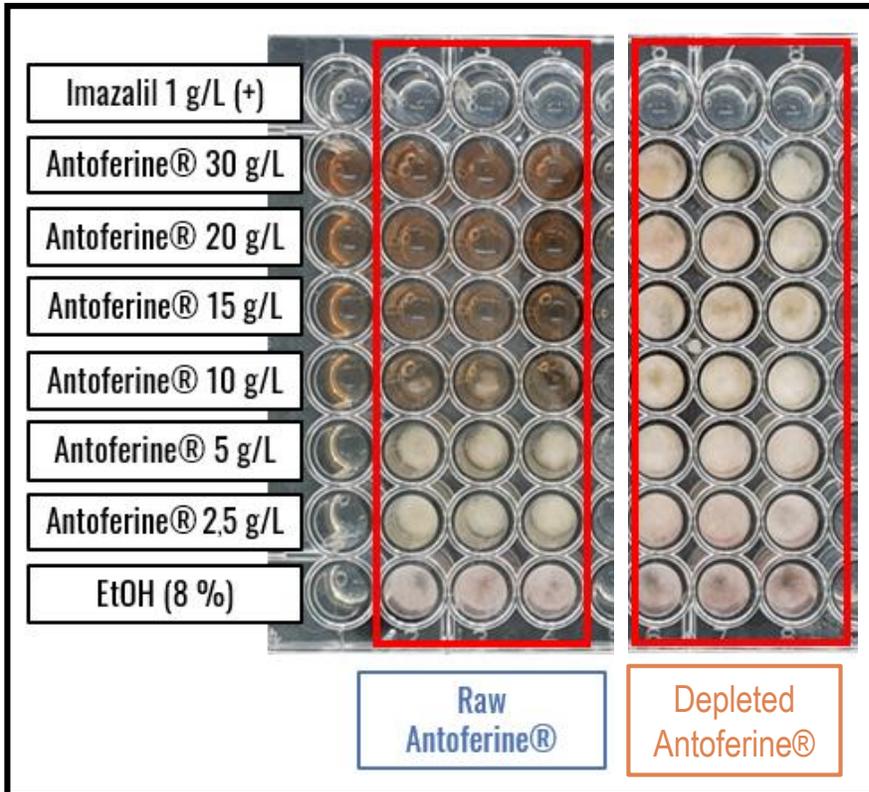
- Antoferine® can block the spore germination

- 5.0 g/L : fungistatic
- 15.0 g/L : sporicide

- Toxin production is suppressed at later stages of development

- Antoferine® does not act as a curative treatment.
- Toxin production is persistently suppressed

# Antoferine® mechanisms of action on *F. graminearum*



- Certain molecules are key to the extract's antifungal effect
- Antoferine® shows molecular synergy

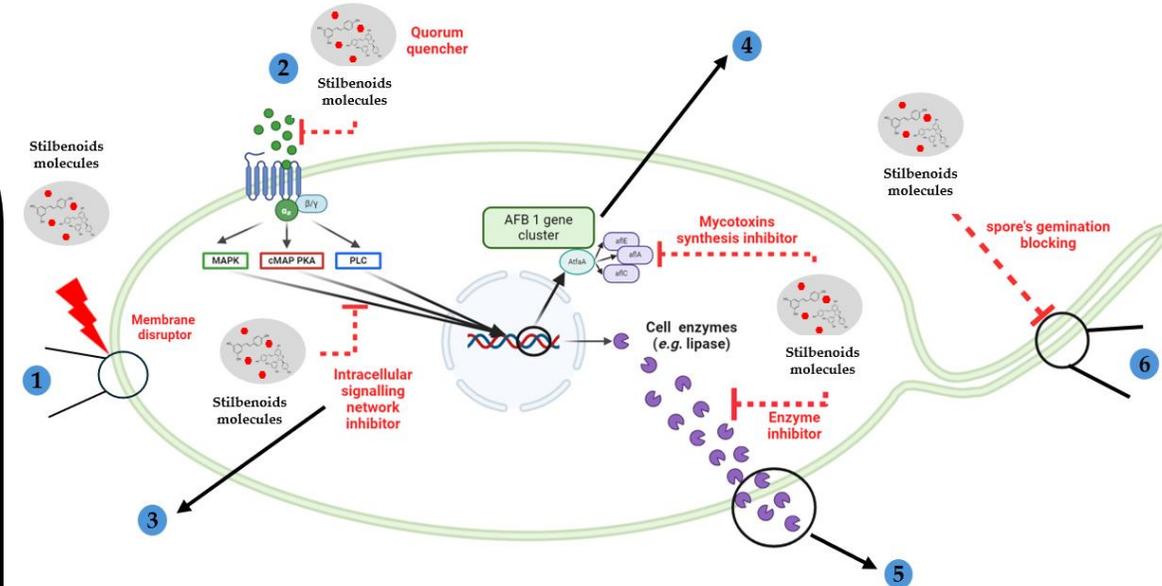
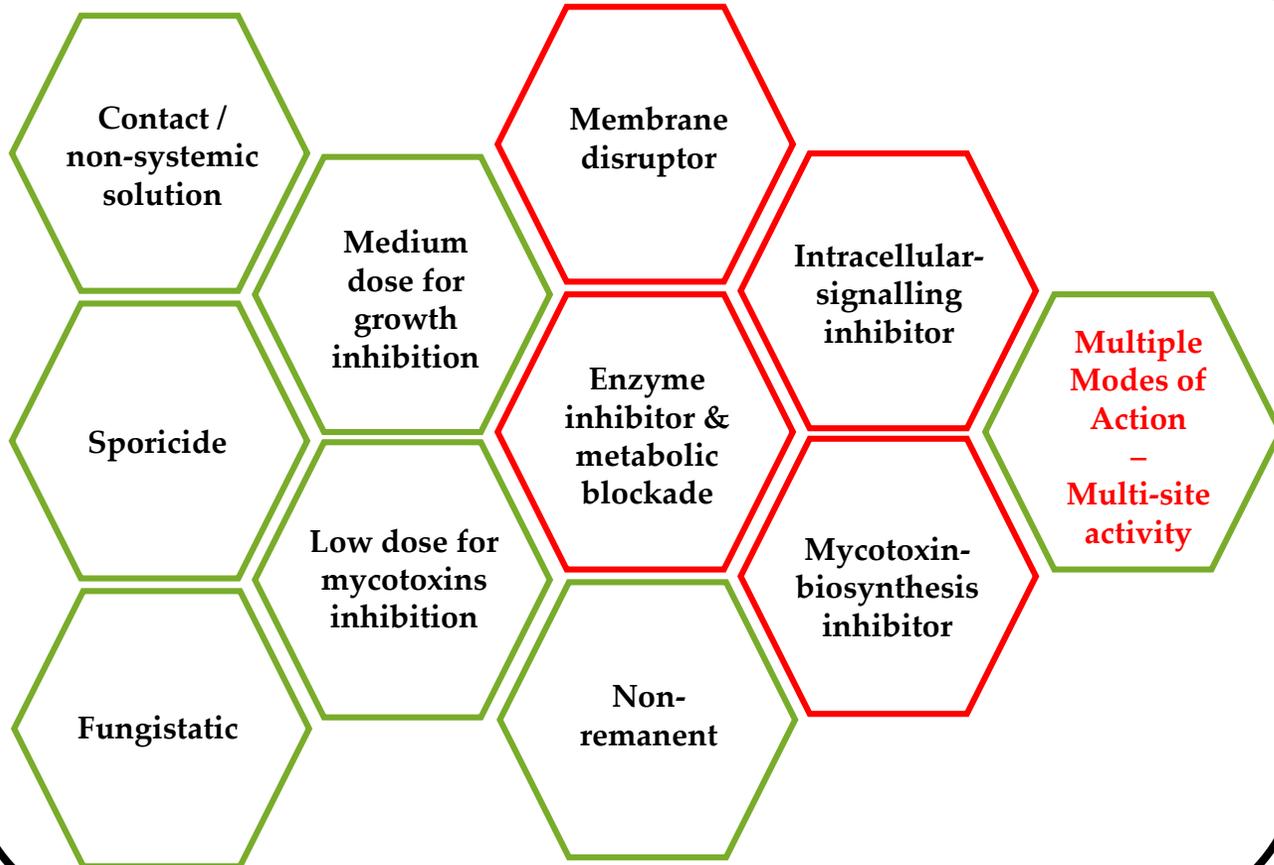
- Proof of concept in wheat spikelets and seeds

- Antoferine® alters membrane integrity and cytoplasmic organization

- Antoferine® perturbs fungal metabolism—impairing toxin synthesis pathways and membrane repair

# Antoferine® an antifungal and antimycotoxigenic biocontrol agent against *F. graminearum*

## Hypothetical FRAC classification of Antoferine®



mechanistic category	primary target / process	key molecular effect
1 Membrane disruptor	fungal wall, plasma-membrane, organelle membranes, lipid bilayer (ergosterol domains)	Intercalation → altered fluidity, rigidified membrane, ergosterol extraction, ion leakage
2 Quorum-sensing quencher	Oxylipin / farnesol signalling, G-protein loops	Oxidation/scavenging of signal molecules
3 Intracellular-signalling inhibitor	MAPK & cAMP-PKA cascades, Ca <sup>2+</sup> flux, ROS signaling, Redox homeostasis	Kinase inhibition, ROS burst or quenching, perturbed antioxidant defences, Ca <sup>2+</sup> chelation
4 Mycotoxin-biosynthesis inhibitor	Cluster regulators (TRI5, TRI6, TRI12, aflR, patK) & precursors	Down-regulation of transcription; NADPH drain



# THANK YOU



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