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# WE JUST DISCOVERED WHAT IS CAUSING ROT OF GARLIC DURING STORAGE IN FRANCE !



## FUSARIUM ON FRENCH GARLIC, ETIOLOGY AND CHARACTERIZATION OF AN EMERGING DISEASE



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Once upon a time in France... Yearly, more than 20000 tons of garlic are produced representing 3500 farmers and 3000 hectares. Since the mid-2000s, and in spite of highly demanding production specifications, a phytopathogenic fungus belonging to genus *Fusarium* has been causing damage in storage leading to root and bulb rots. The annual losses have a major impact on the viability of the French garlic industry.

Two major objectives were to :

- Elucidate the **etiology** of this disease of garlic.
- Develop a test to evaluate the **aggressiveness** of strains.



### DISEASE, TELL ME YOUR NAME

#### Obtaining the fungal material

- 1 Collect symptomatic cloves from different types of garlic, areas and dates of production.
- 2 Isolate fungi from surface-disinfected cloves.
- 3 Identify with molecular tools (Elongation Factor gene).

#### Results

2000 strains of *Fusarium* were isolated, of which :

98% *F. proliferatum* (Fp) – 2% *F. oxysporum*.



### HOW DANGEROUS ARE YOU ?

#### Aggressiveness test

Surface-sterilized cloves were soaked in  $10^6$  spores/mL, symptoms noted for 18 days (23°C, 100% humidity) relative to a reference strain (FA3-E01).

#### Results

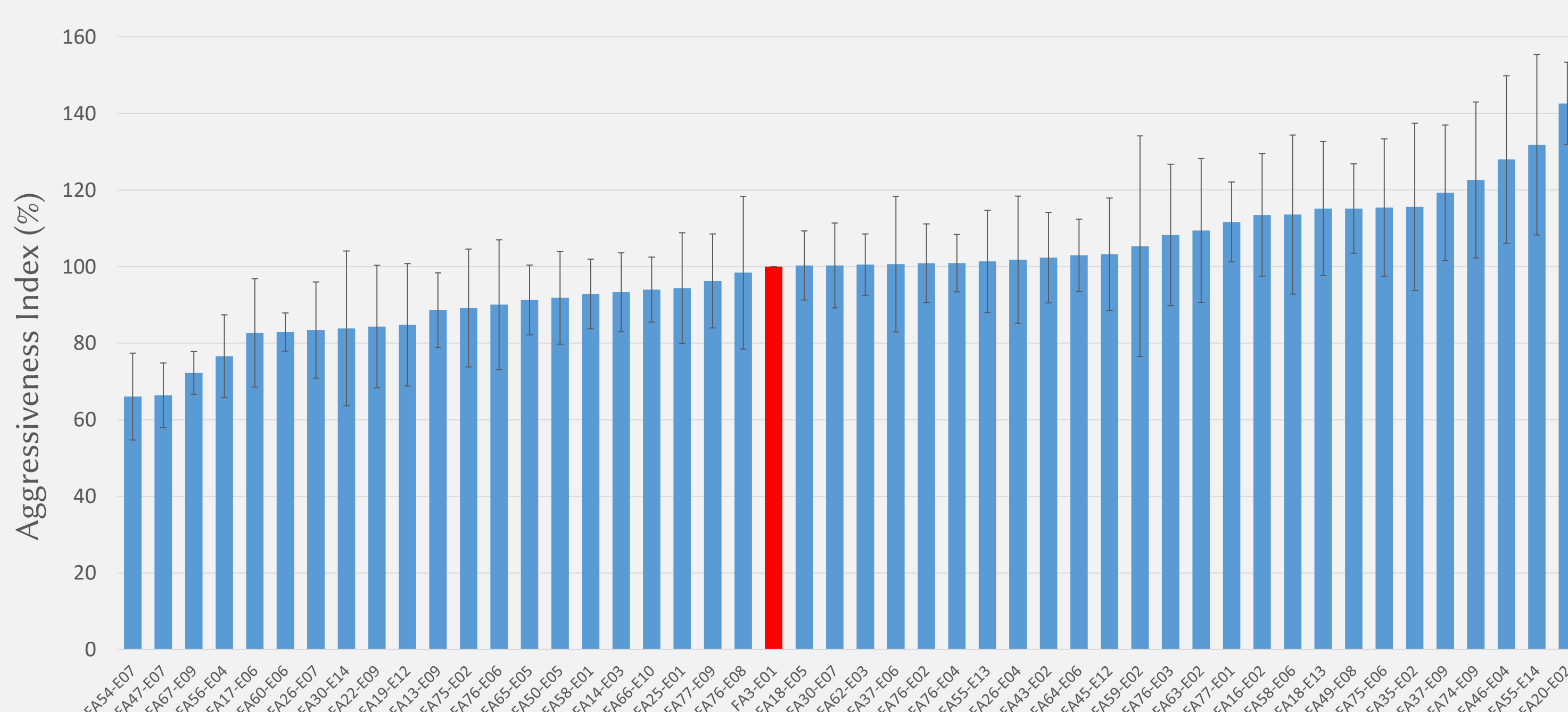


Figure 1 – Aggressiveness index of all *F. proliferatum* strains each tested on 12 garlic cloves



### HOW DID YOU GET IN THERE ?

#### Microscopy

- 1 Healthy and inoculated cloves were observed at 1, 2, 3 and 4 days post inoculation.
- 2 Roots, basal plate and leaf scales were observed with light microscopy and SEM

#### Results

Fp appeared to enter and grow through **natural wounds** (A).

Germination and development of spores and mycelium induced near **collapsed dead cells** around roots (B).

Fp colonizes **dead cells** and appears to cause **degradation** of garlic tissue **from distance** (C)

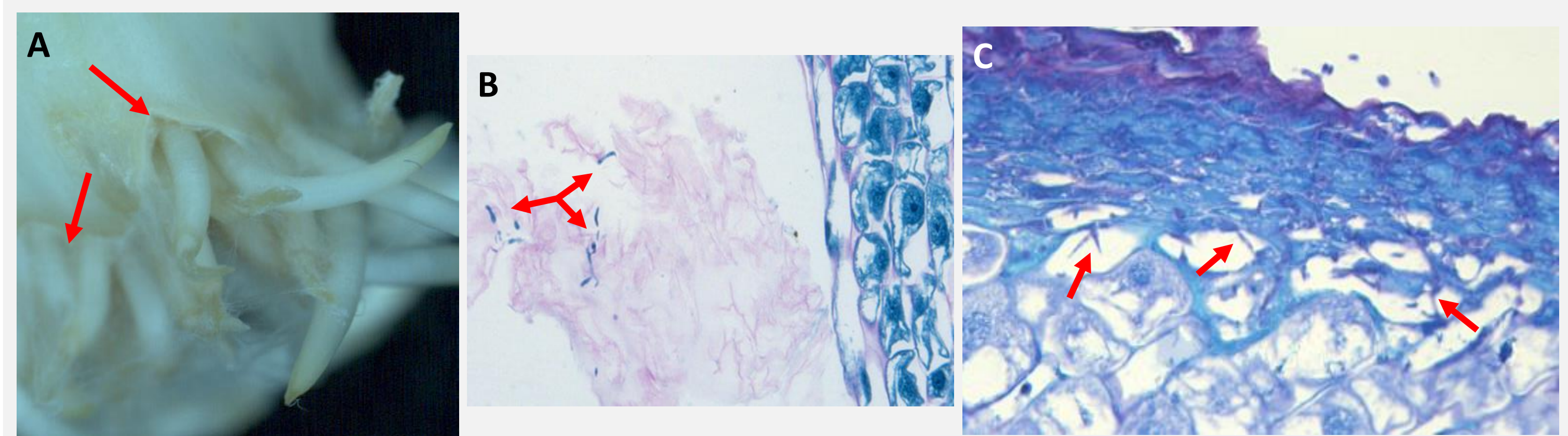


Figure 2 – (A) 72h post-inoculation, roots emerging from the basal plate of the clove and development of mycelium in junctions and around roots. (B) 24h post-inoculation, spores germinating inside collapsed dead cells resulting from the root (right) emergence. (C) 72h post-inoculation, mycelium at the interface between dead cells (in deep blue, top) and healthy cells (in light blue, bottom). Arrows indicate mycelium.



### WHAT DID WE LEARN ?

- ▶ *F. proliferatum* is the main pathogen causing rot of garlic during storage in France
- ▶ All strains are virulent with varying degrees of aggressiveness
- ▶ Fp seems to enter through wounds, develop inside cellular debris and secrete enzymes and toxins before entering inside dead cells

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