Fire blight: history, management, and new challenges

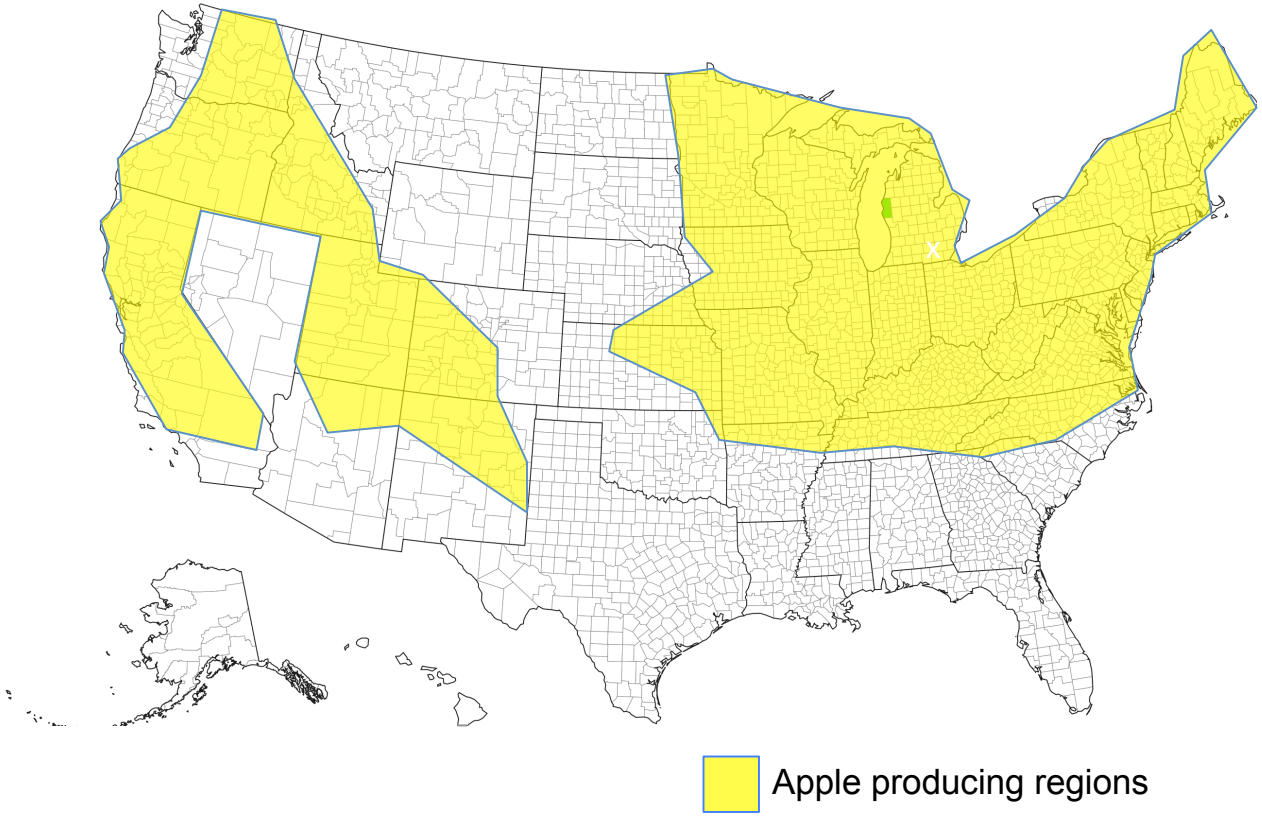
Quan Zeng

Department of Plant Pathology and Ecology

The Connecticut Agricultural Experiment Station

Fire blight: a devastating disease of apple and pear

- Apple is the #1 most consumed fruit produced in the U.S.



240 Million Bushels

4 billion dollars

Fire blight: a devastating disease of apple and pear

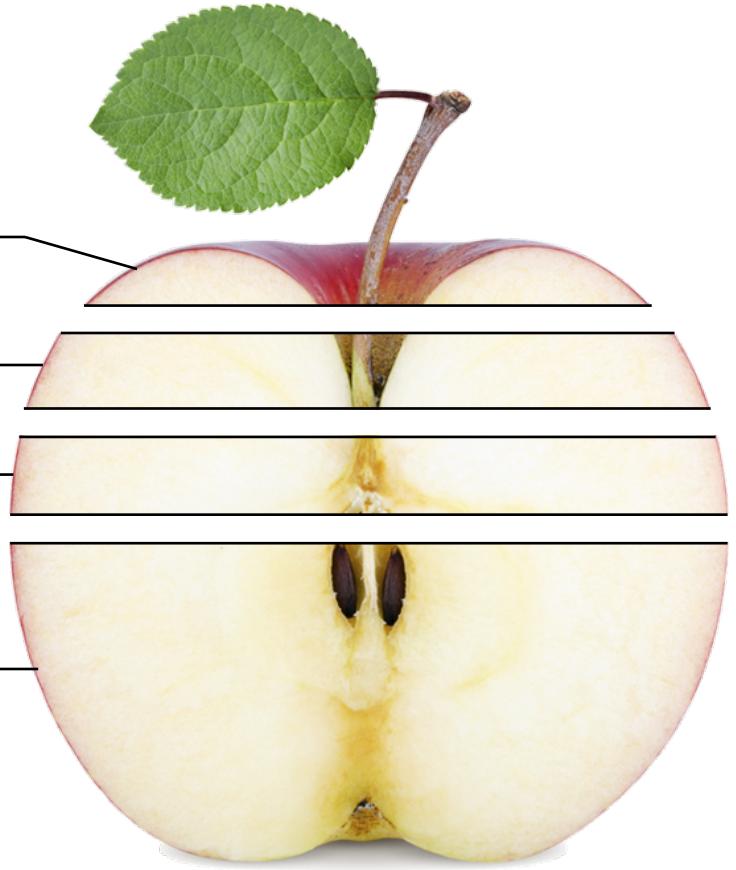
- Apple is the #1 most consume fruit produced in the U.S.

6% Cider

12% Juice and slices

15% Applesauce

67% Fresh market

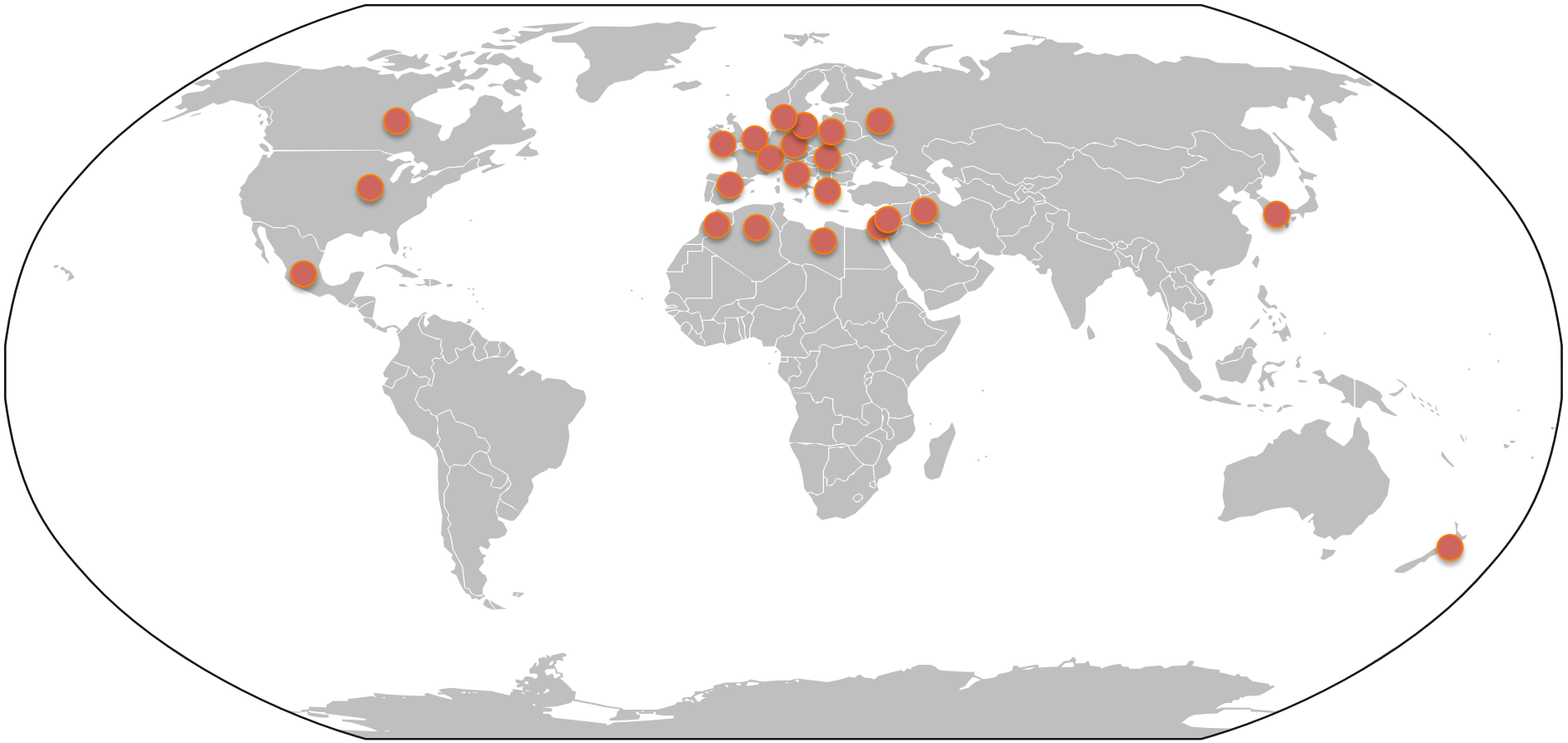


Fire blight: a devastating disease of apple and pear

- Apple is the #1 most consume fruit produced in the U.S.
- Fire blight is one of the top two diseases of apple.
- Caused by a bacterial pathogen *Erwinia amylovora*.

Symptoms

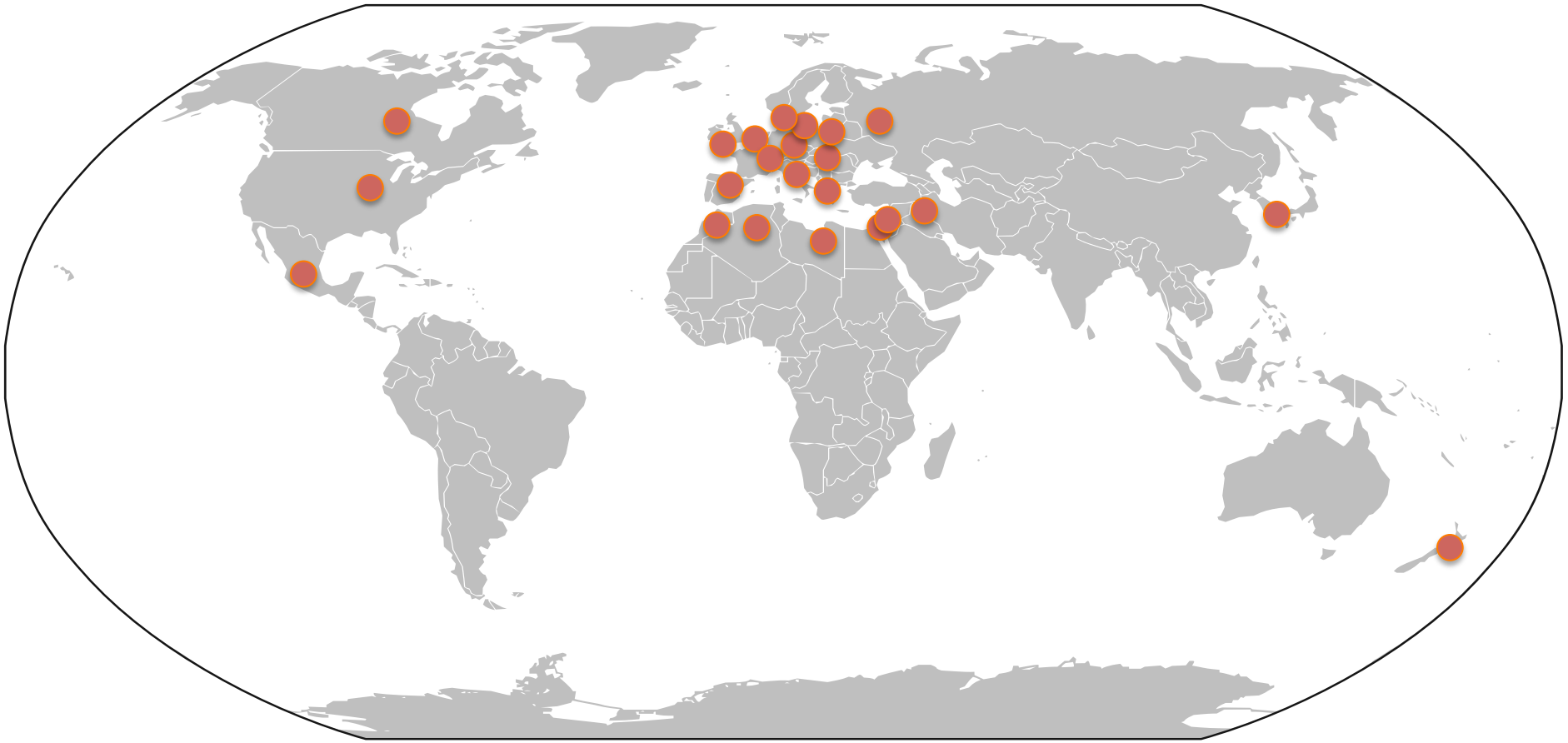
Fire blight is widely prevalent in the U.S. and worldwide



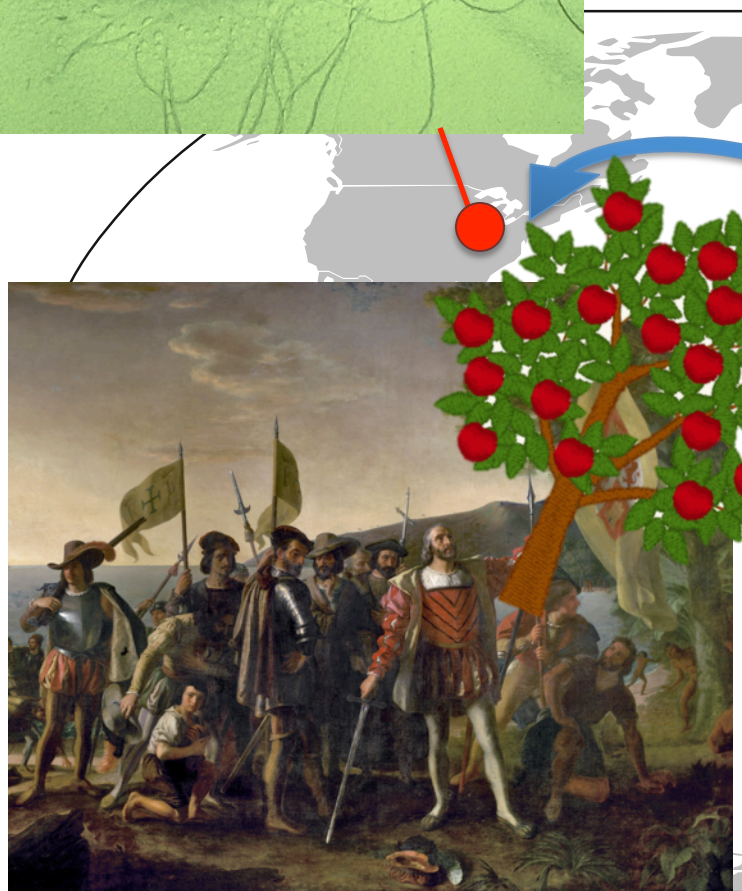
Fire blight is a major threat to Connecticut apple orchards

Fire blight is a major threat to Connecticut apple orchards

How did fire blight emerge and spread?

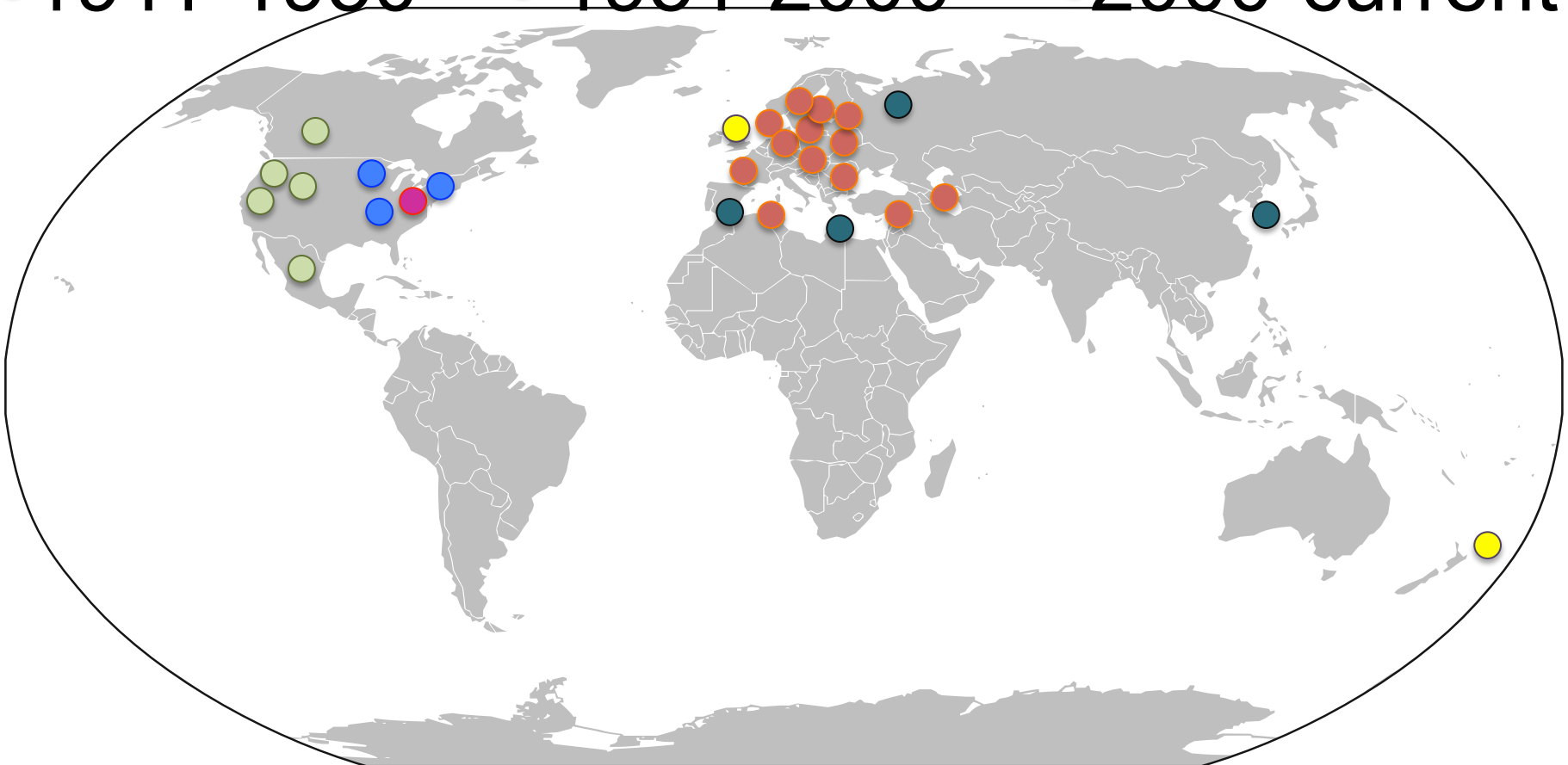


How did fire blight emerge and spread?



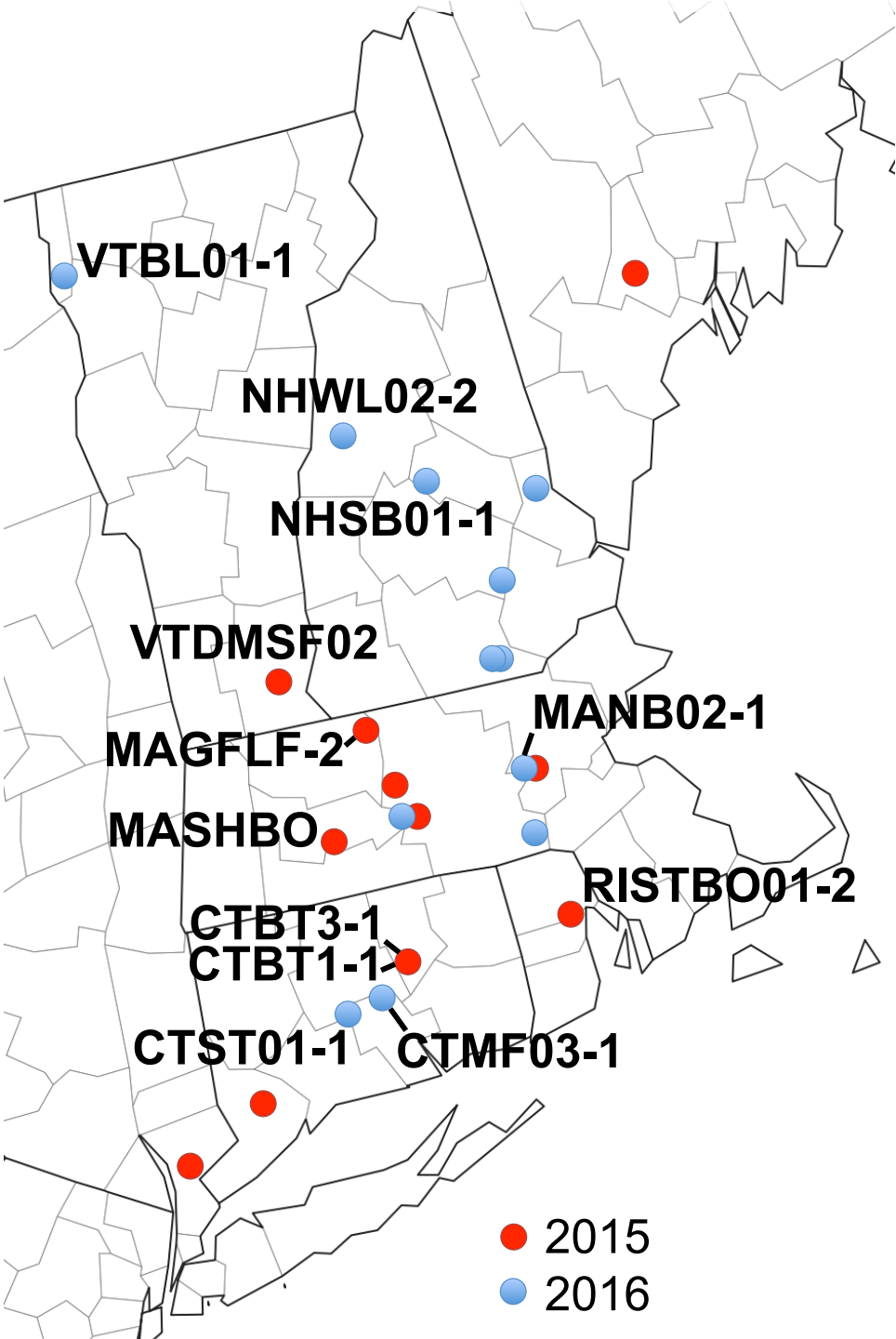
How did fire blight emerge and spread?

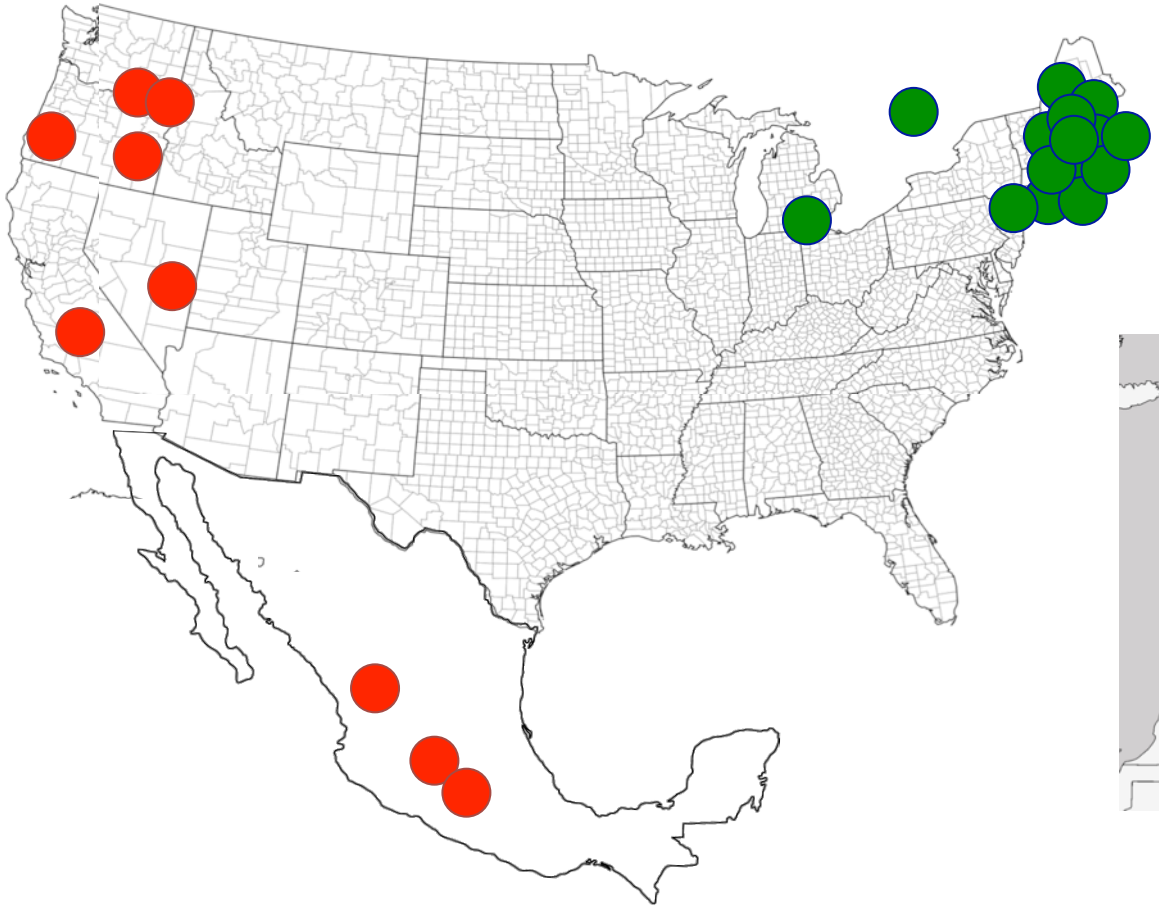
- 1750-1800
- 1801-1850
- 1851-1910
- 1911-1950
- 1951-2000
- 2000-current

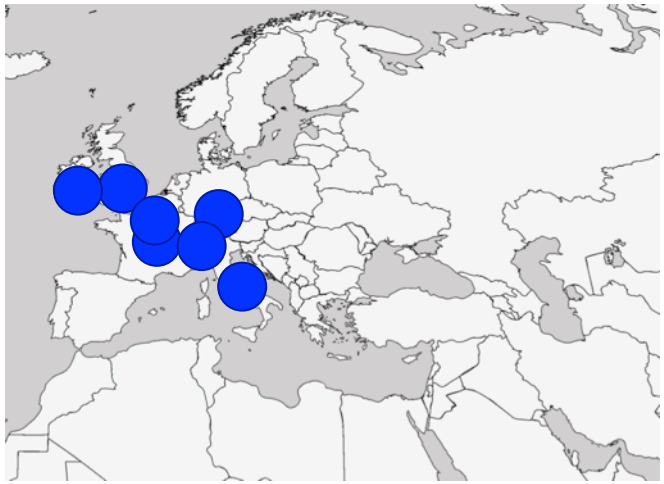


- Collect *E. amylovora* strains in New England.

Northeastern IPM Center



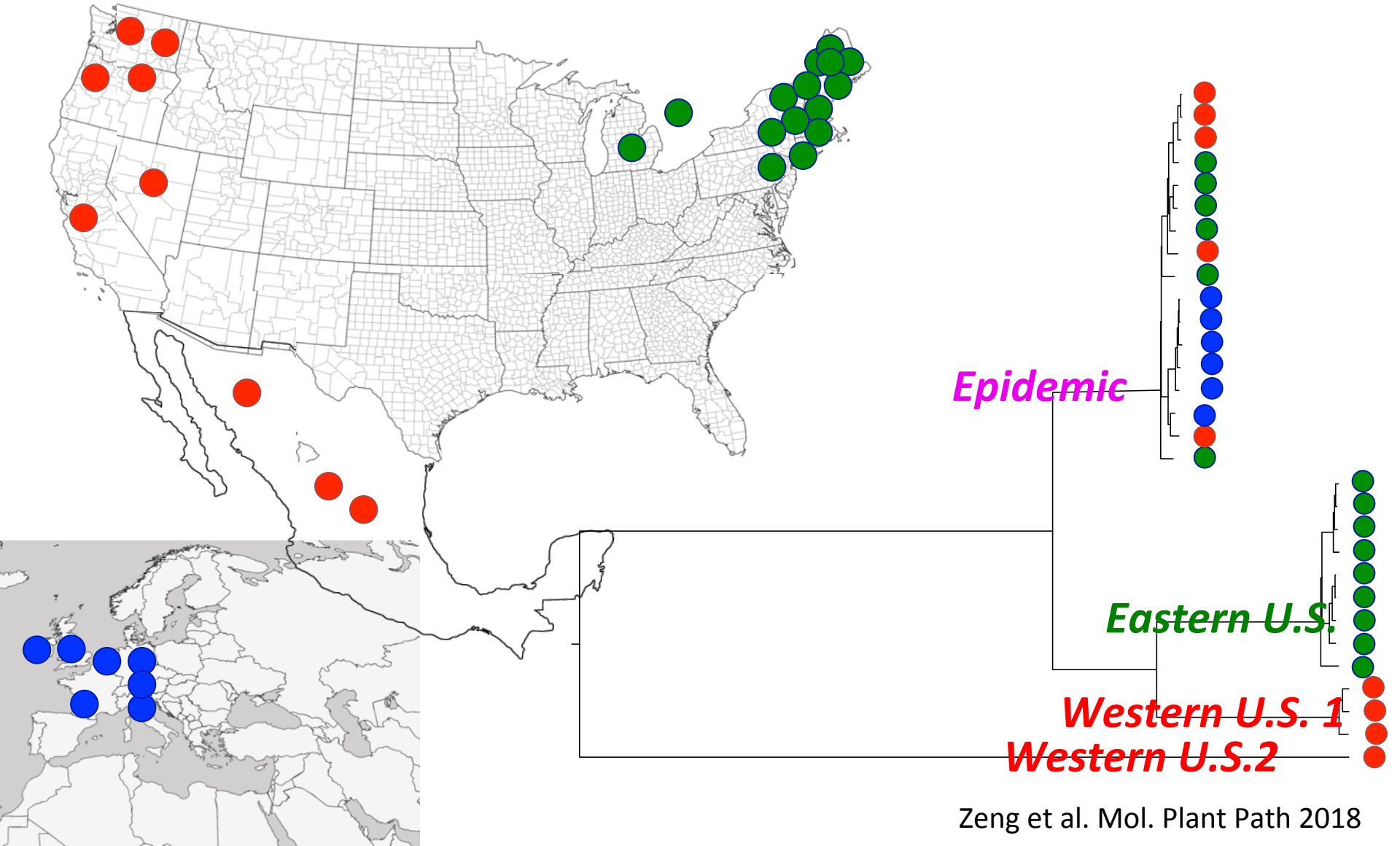




- Sequenced bacterial genomes
- Genomes comparison

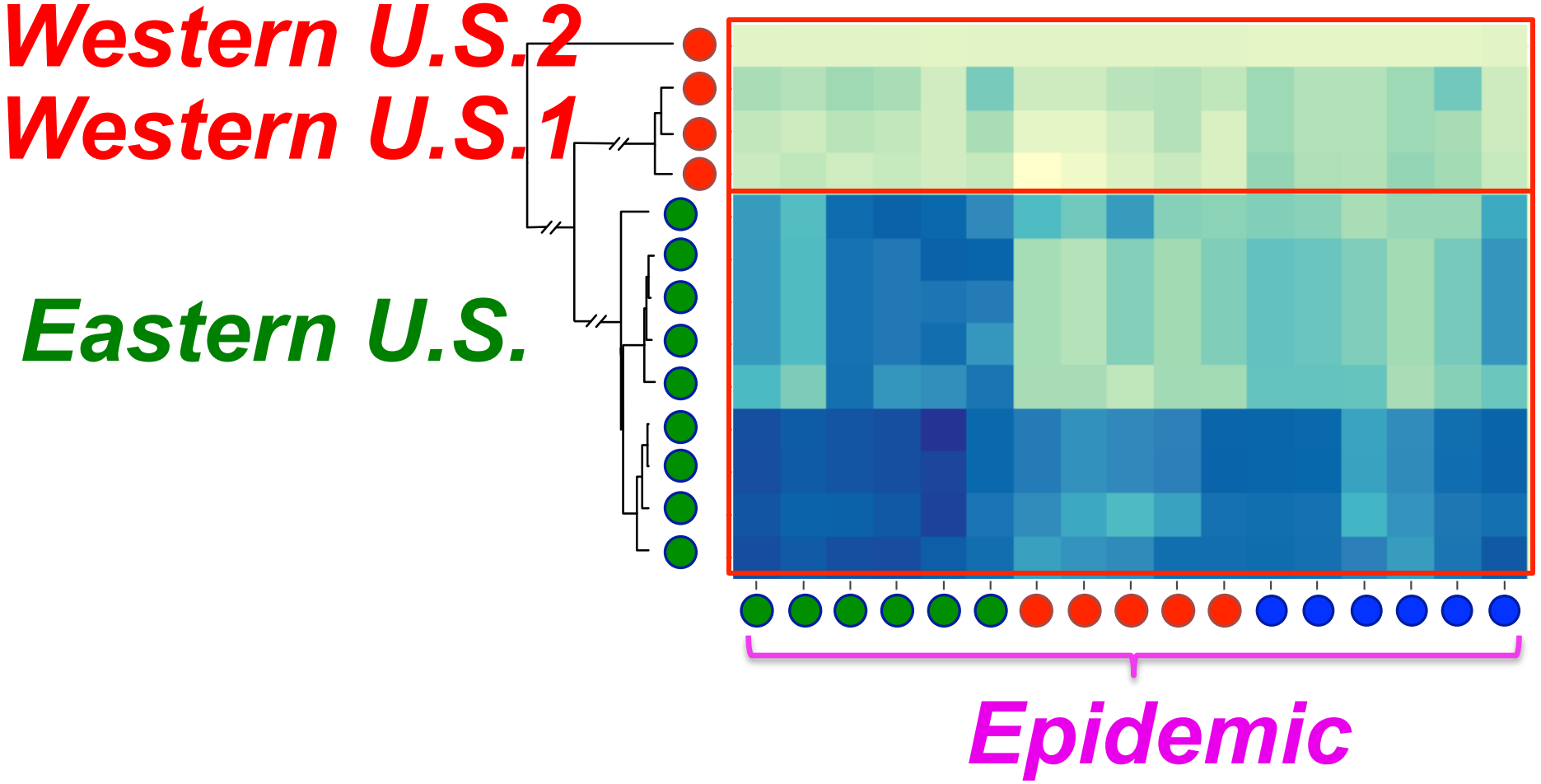
Zeng et al. Mol. Plant Path 2018

E. amylovora in North America and Europe belong to 4 genetically distinct groups.



Zeng et al. Mol. Plant Path 2018

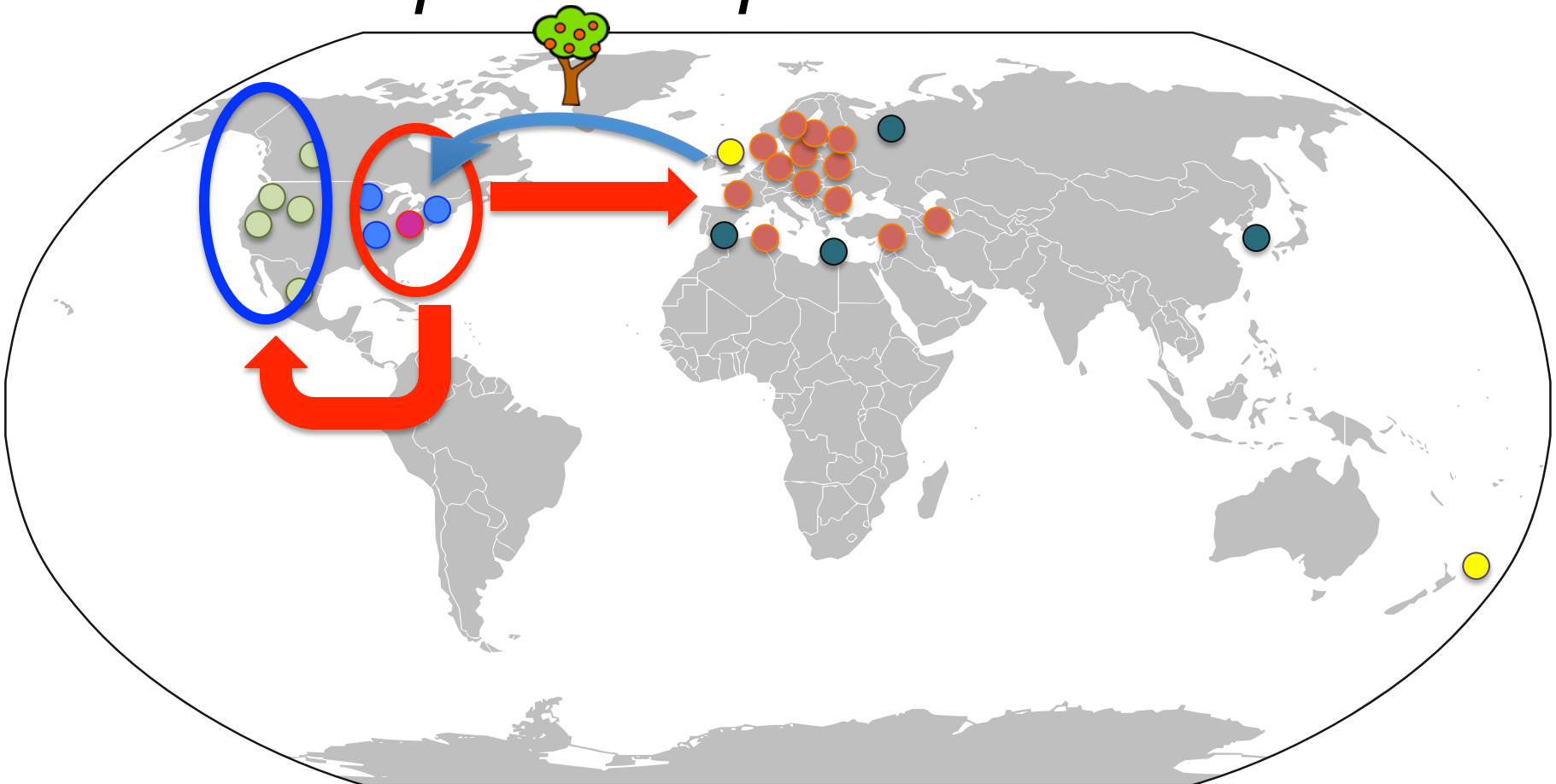
Recombination (DNA exchange) detected at the genome level.



Epidemic group originates in the Eastern U.S.

How did fire blight emerge and spread?

Transportation of plant materials facilitates the spread of plant diseases!



Fire blight management

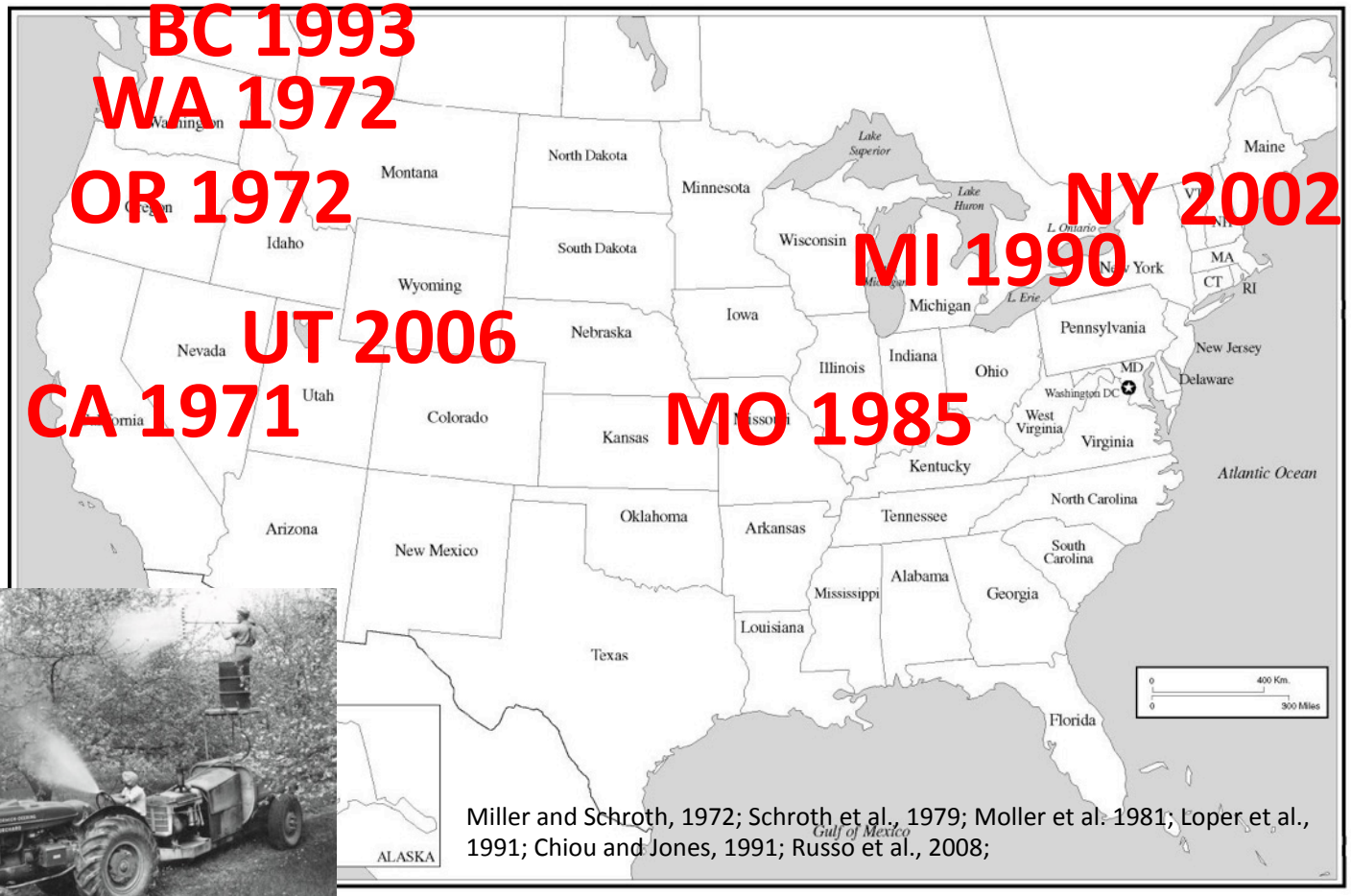
Fire blight management

- Is antibiotic the ‘silver bullet’ for fire blight management?

Antibiotic application in plant production

- Raises concerns for its impact to the environment and human health
- Induced antibiotic resistance in the pathogens and resulted in ineffectiveness in disease management.

Streptomycin resistance in *E. amylovora* in the U.S.



Miller and Schroth, 1972; Schroth et al., 1979; Moller et al. 1981; Loper et al., 1991; Chiou and Jones, 1991; Russo et al., 2008;

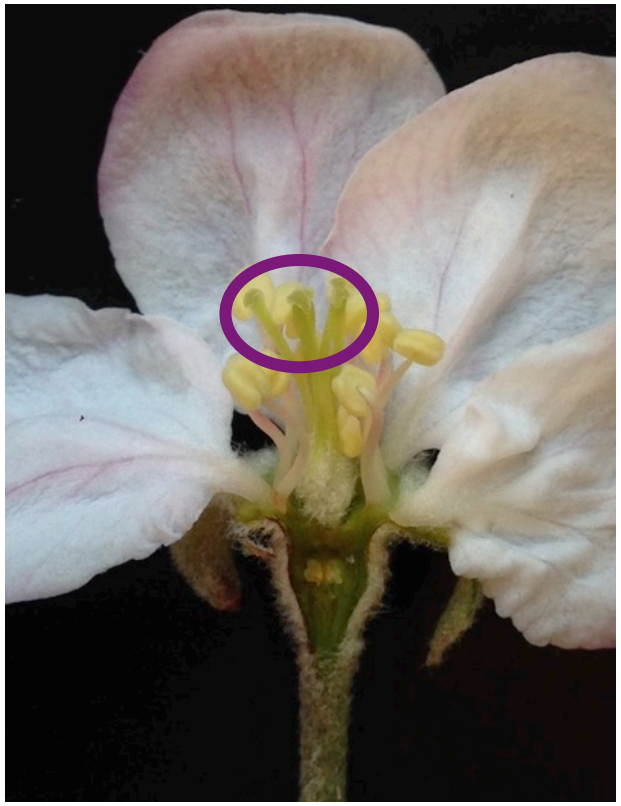
How can we manage fire blight with less or no antibiotics?

Research Objectives

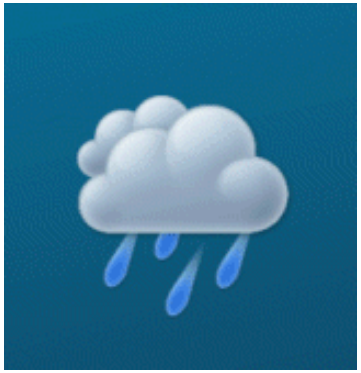
- Determine the necessity of antibiotic application of according to environmental conditions.

- Develop biological control materials as alternatives to antibiotics.

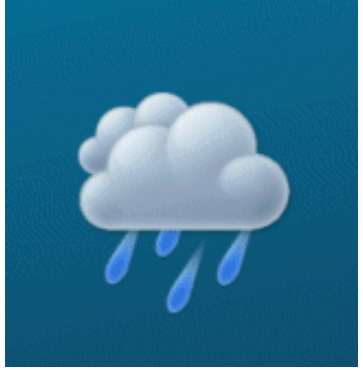
Effect of humidity on pathogen growth and virulence



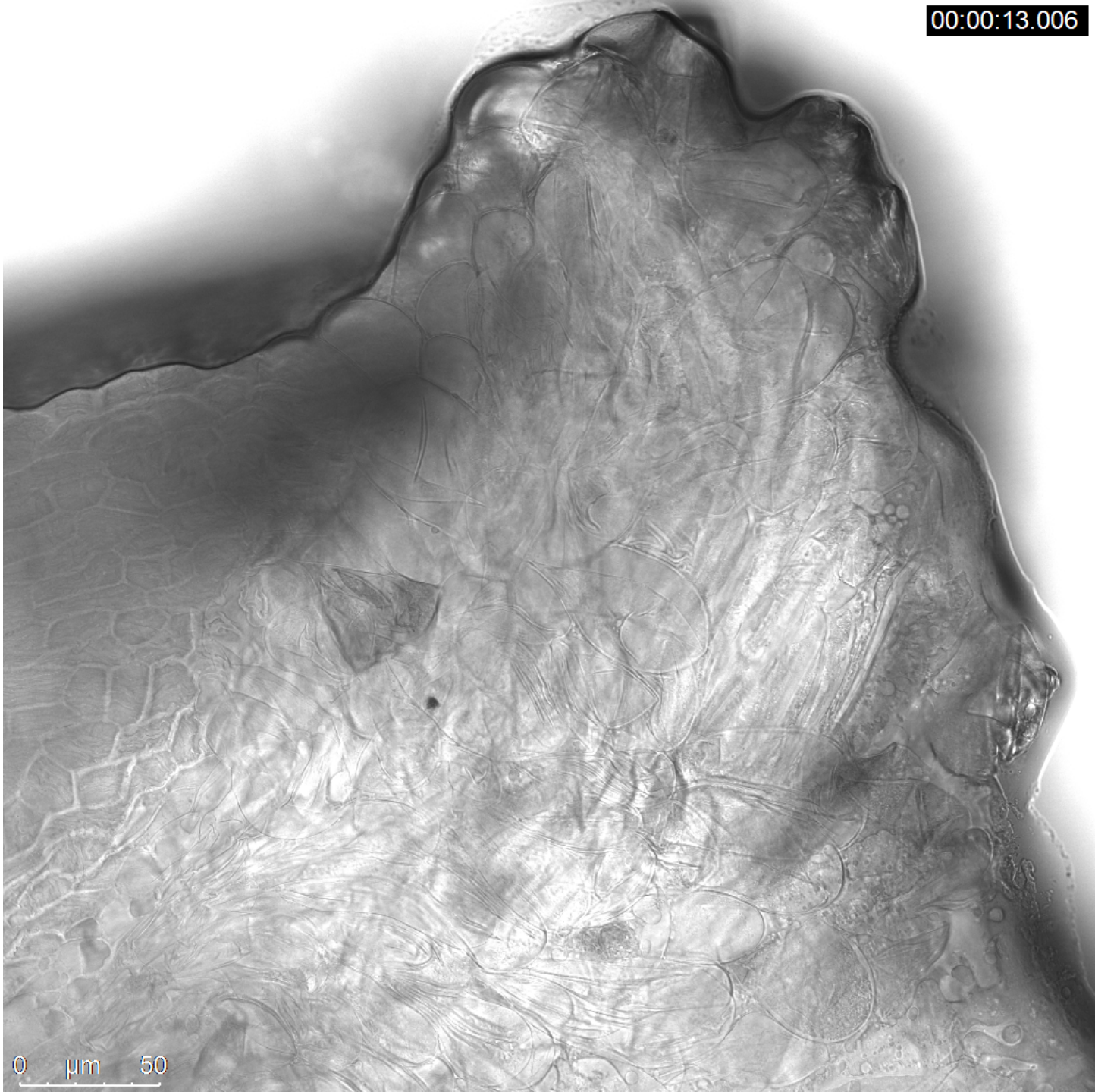
Low humidity

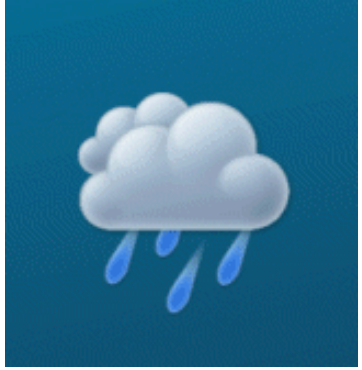


High humidity

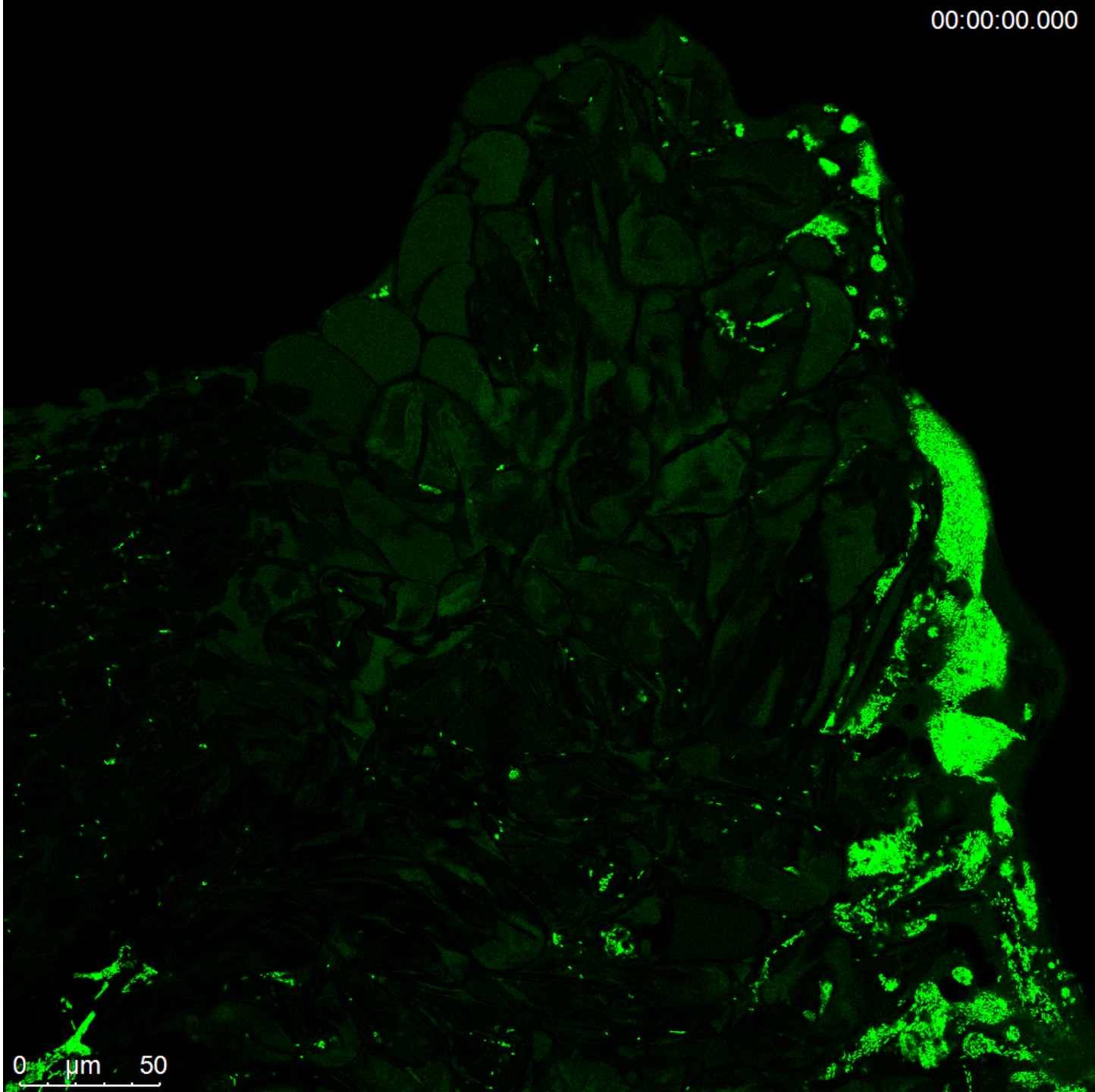


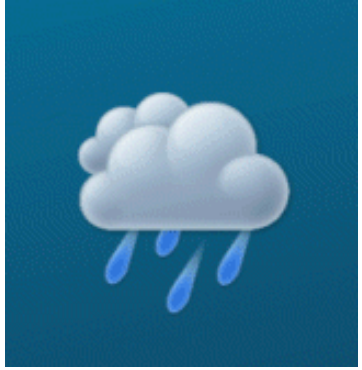
High humidity



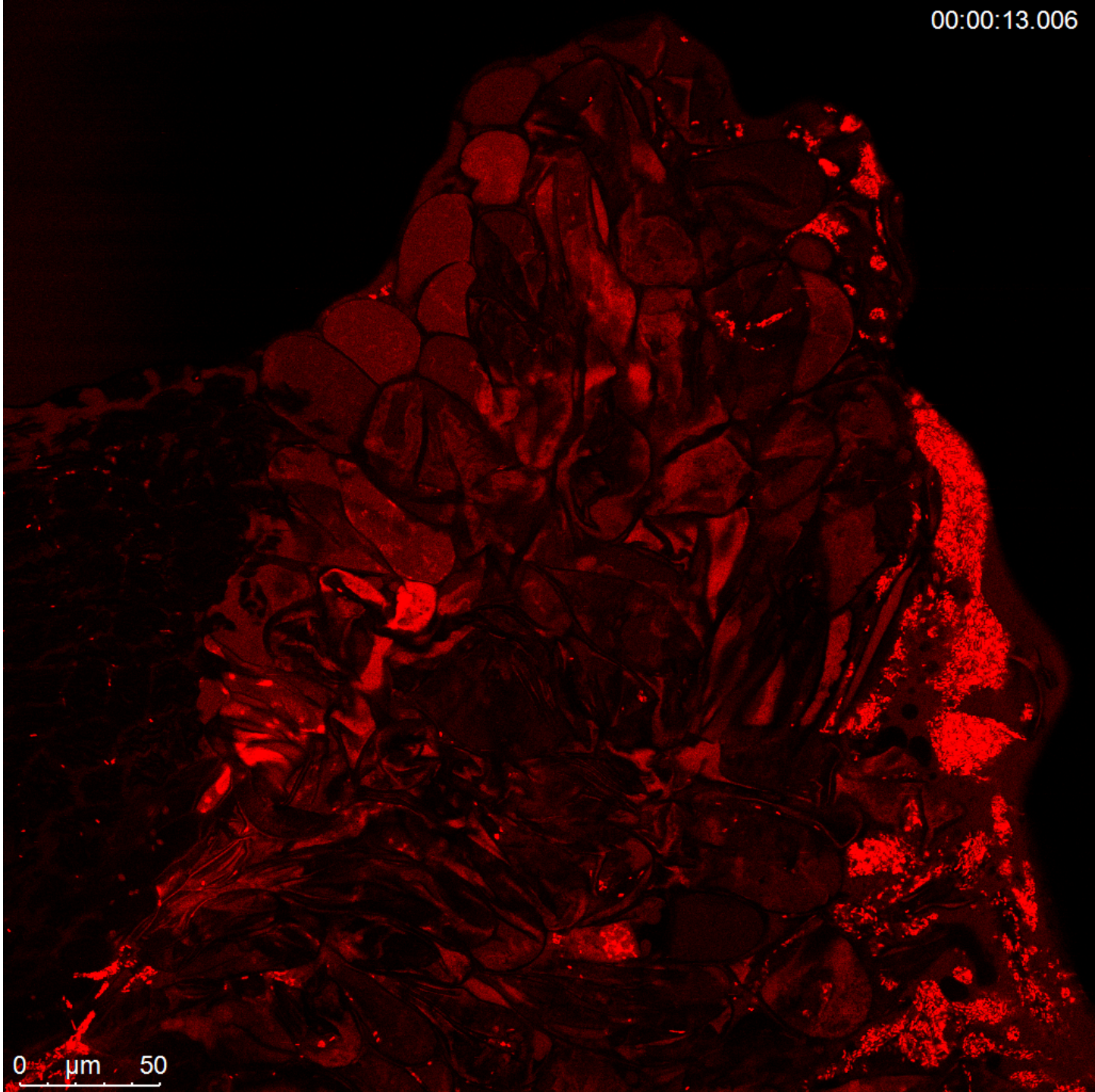


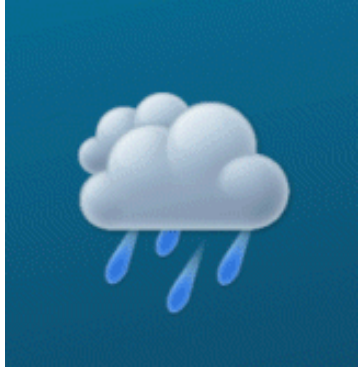
High humidity



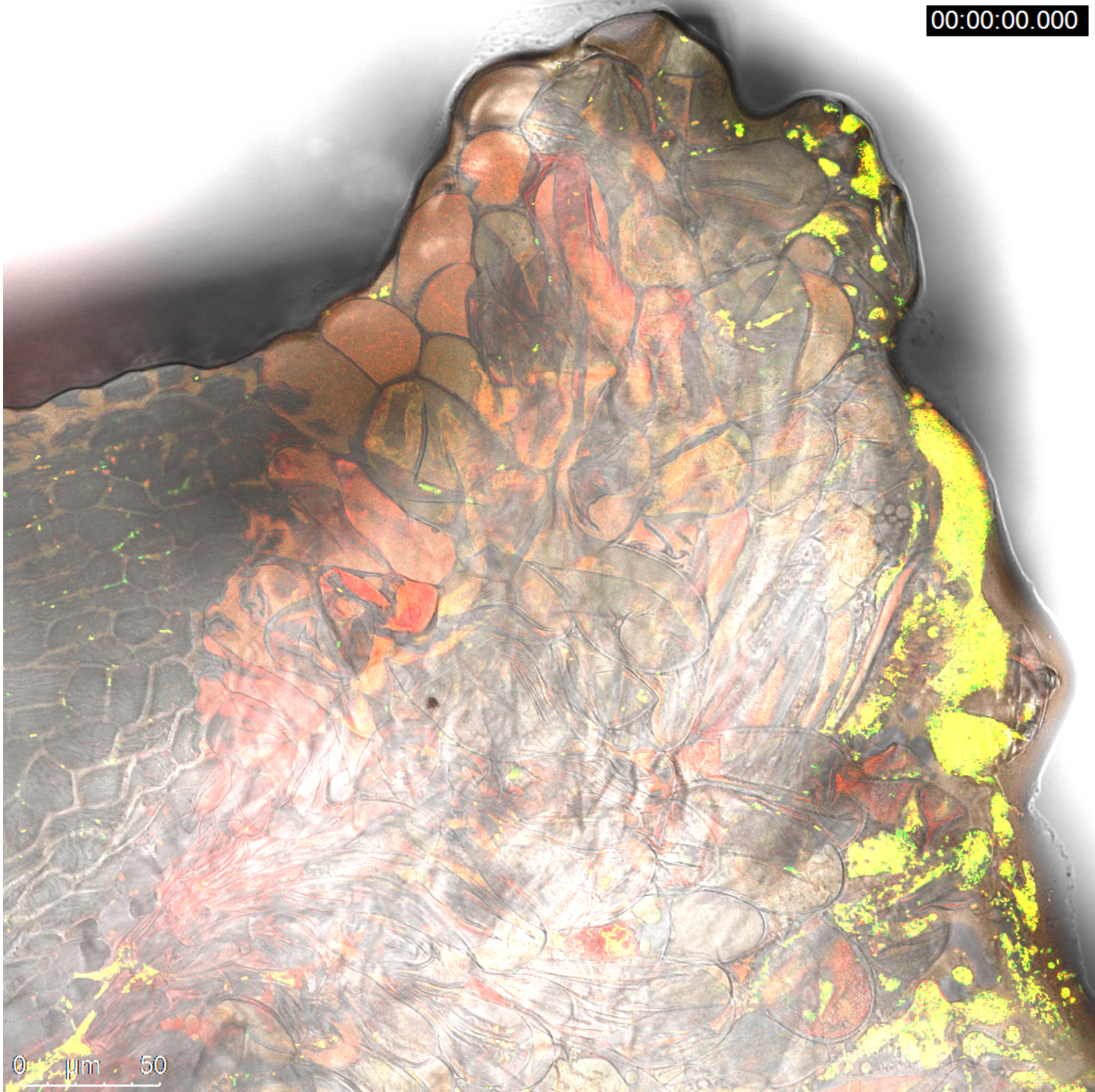


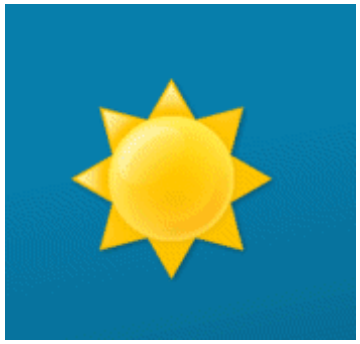
High humidity



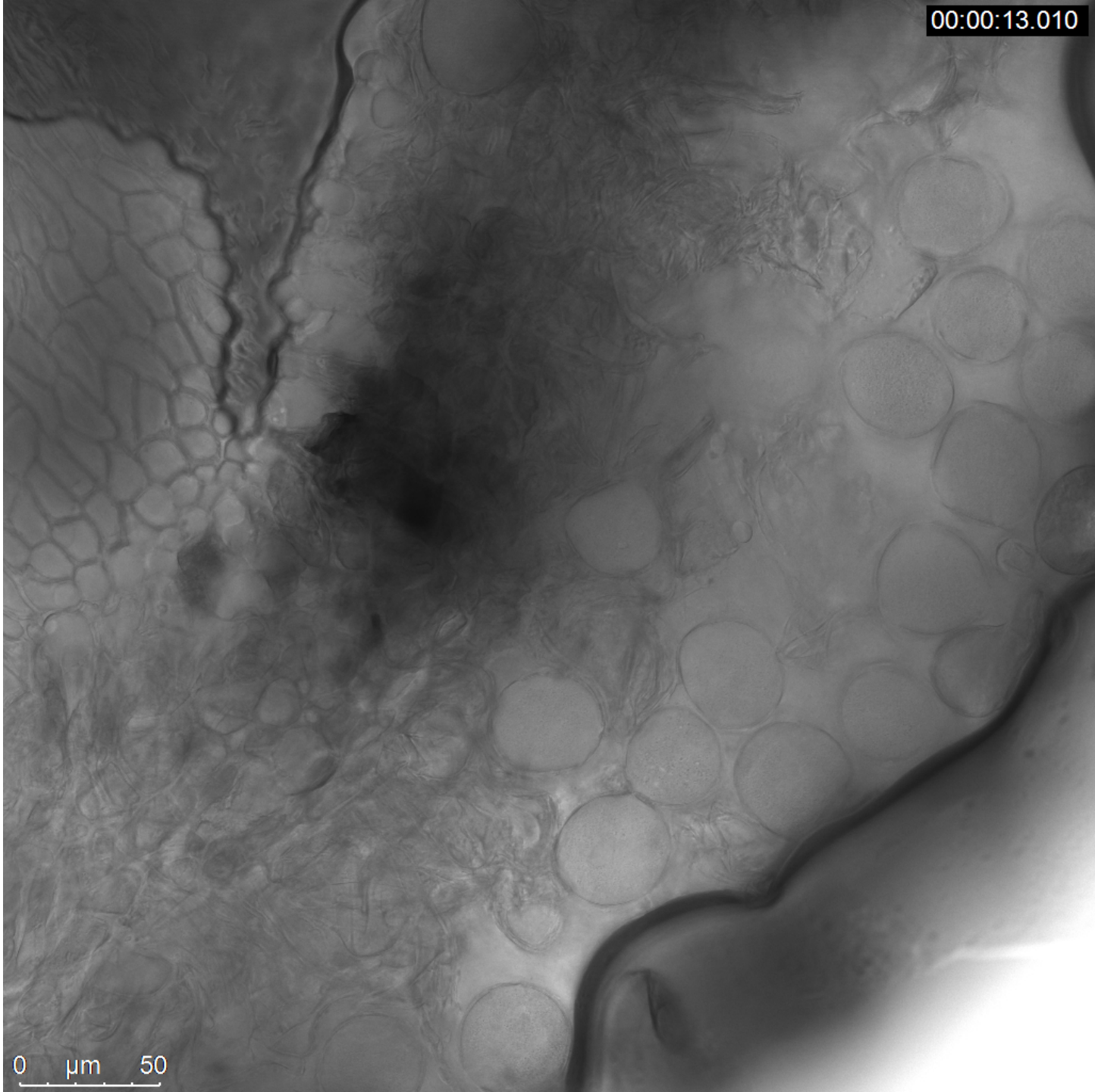


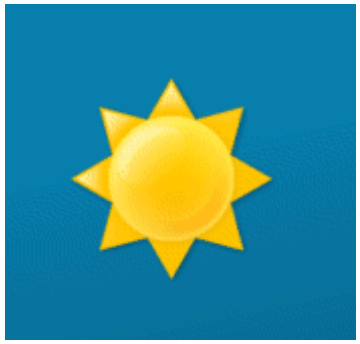
High humidity



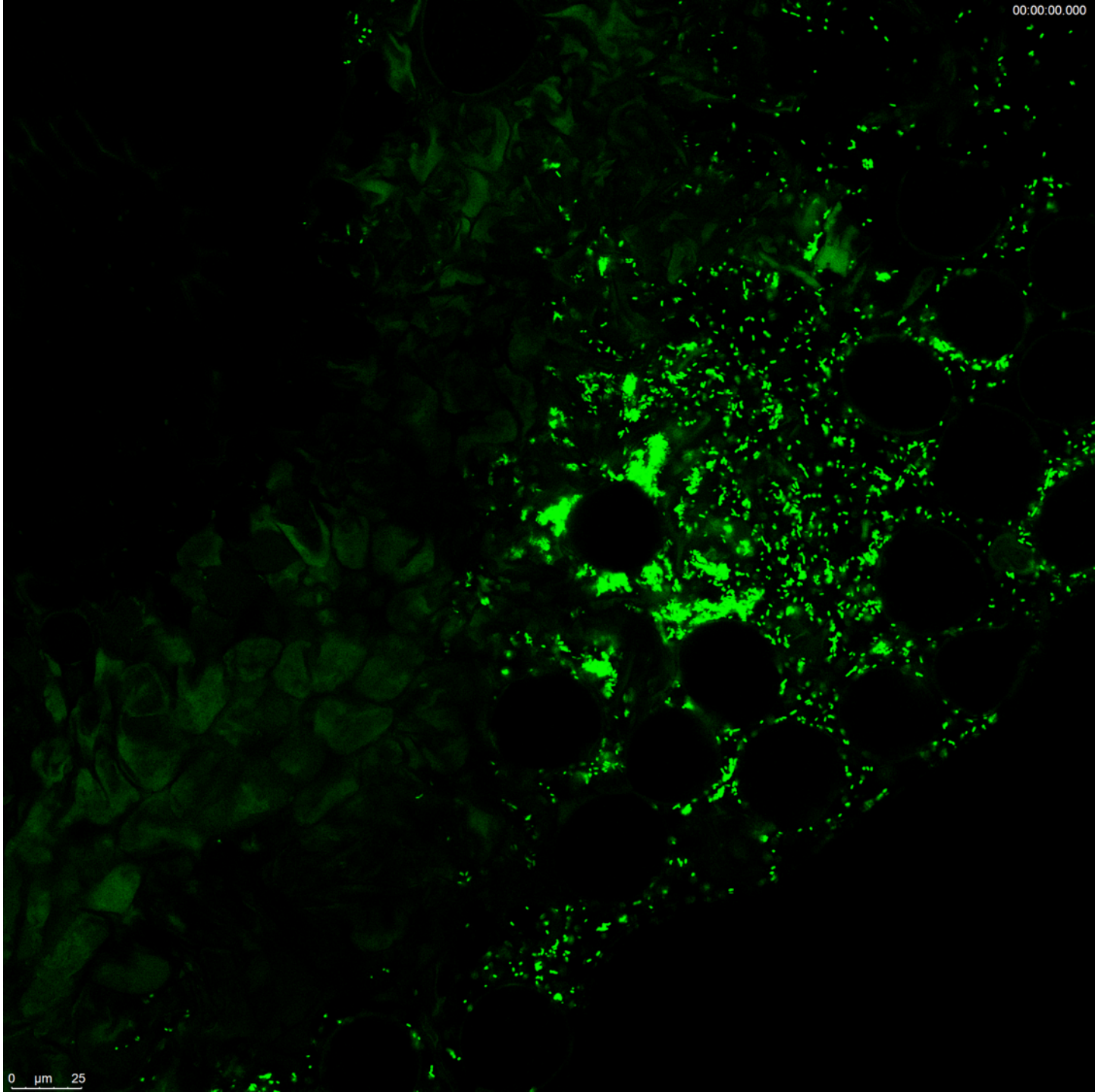


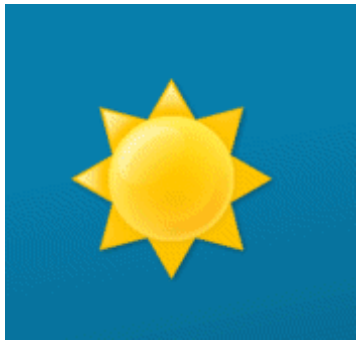
Low humidity



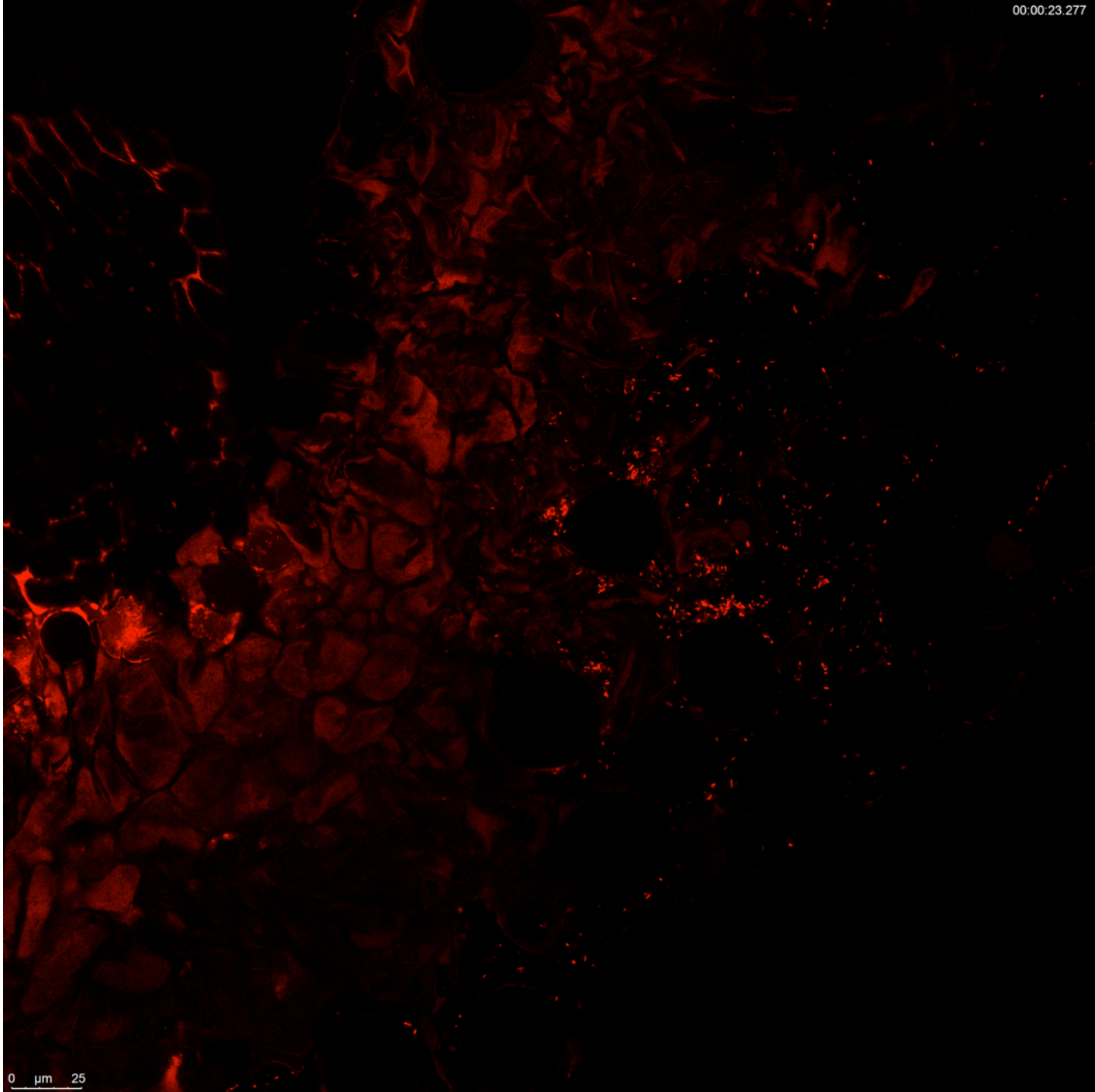


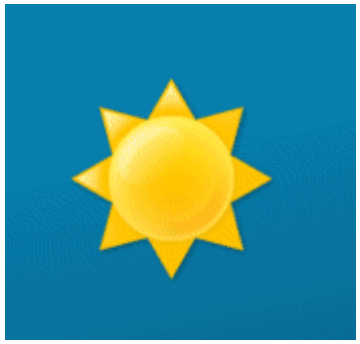
Low humidity



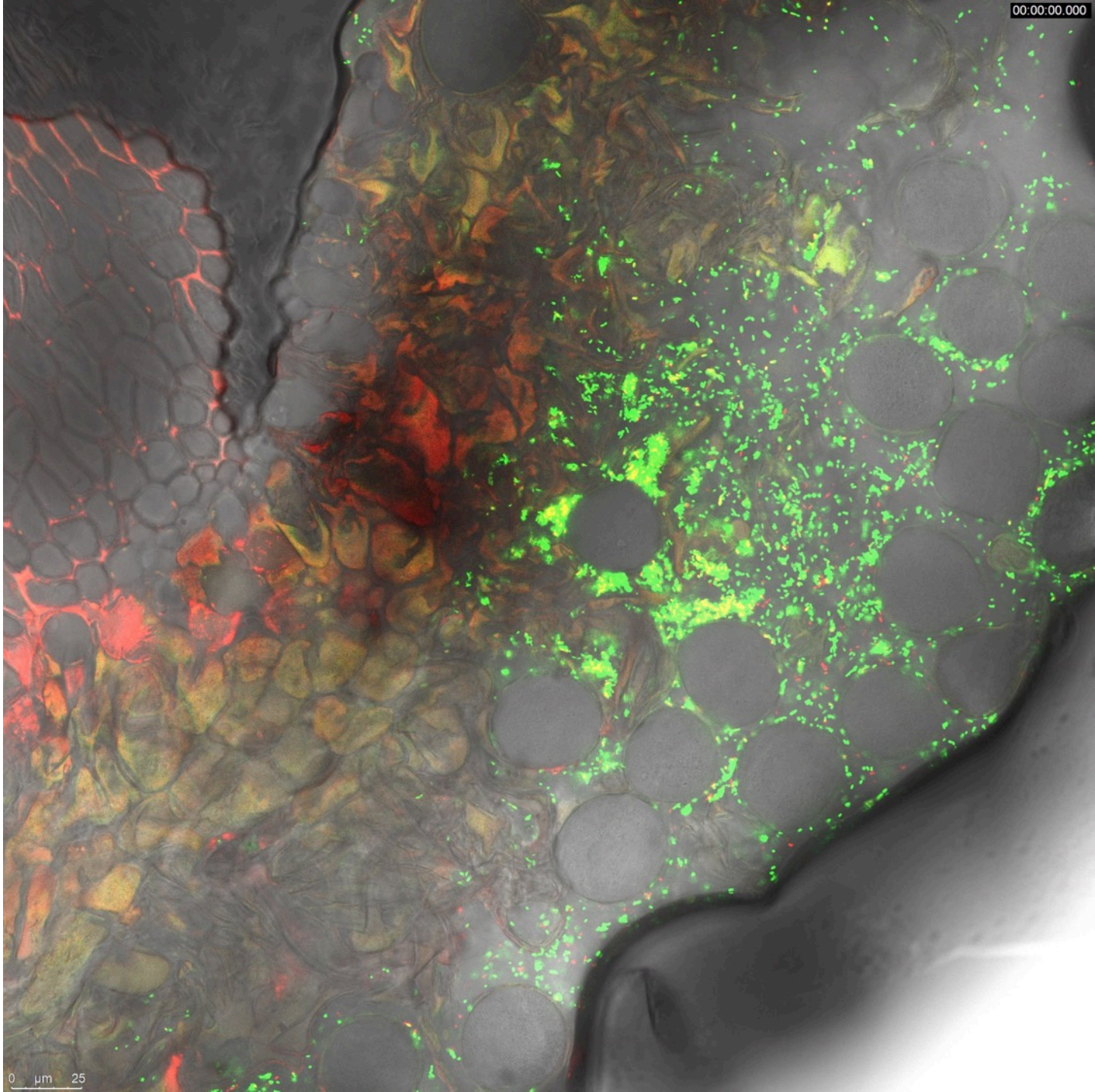


Low humidity

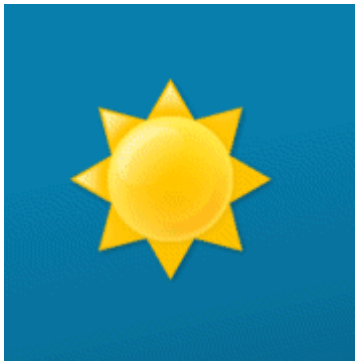




Low humidity



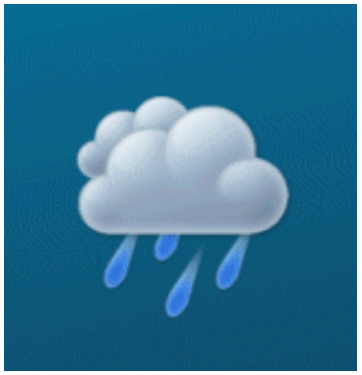
Humidity affects disease occurrence



Low humidity

grow slower

less virulent



High humidity

grow faster

more virulent

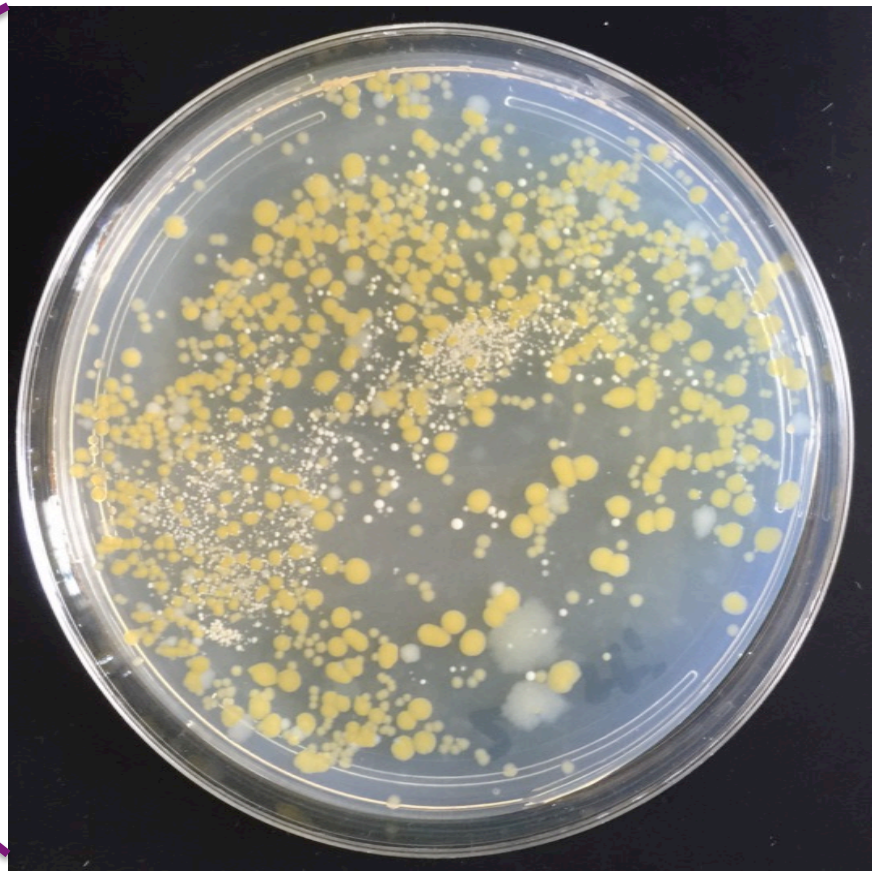
Antibiotic application

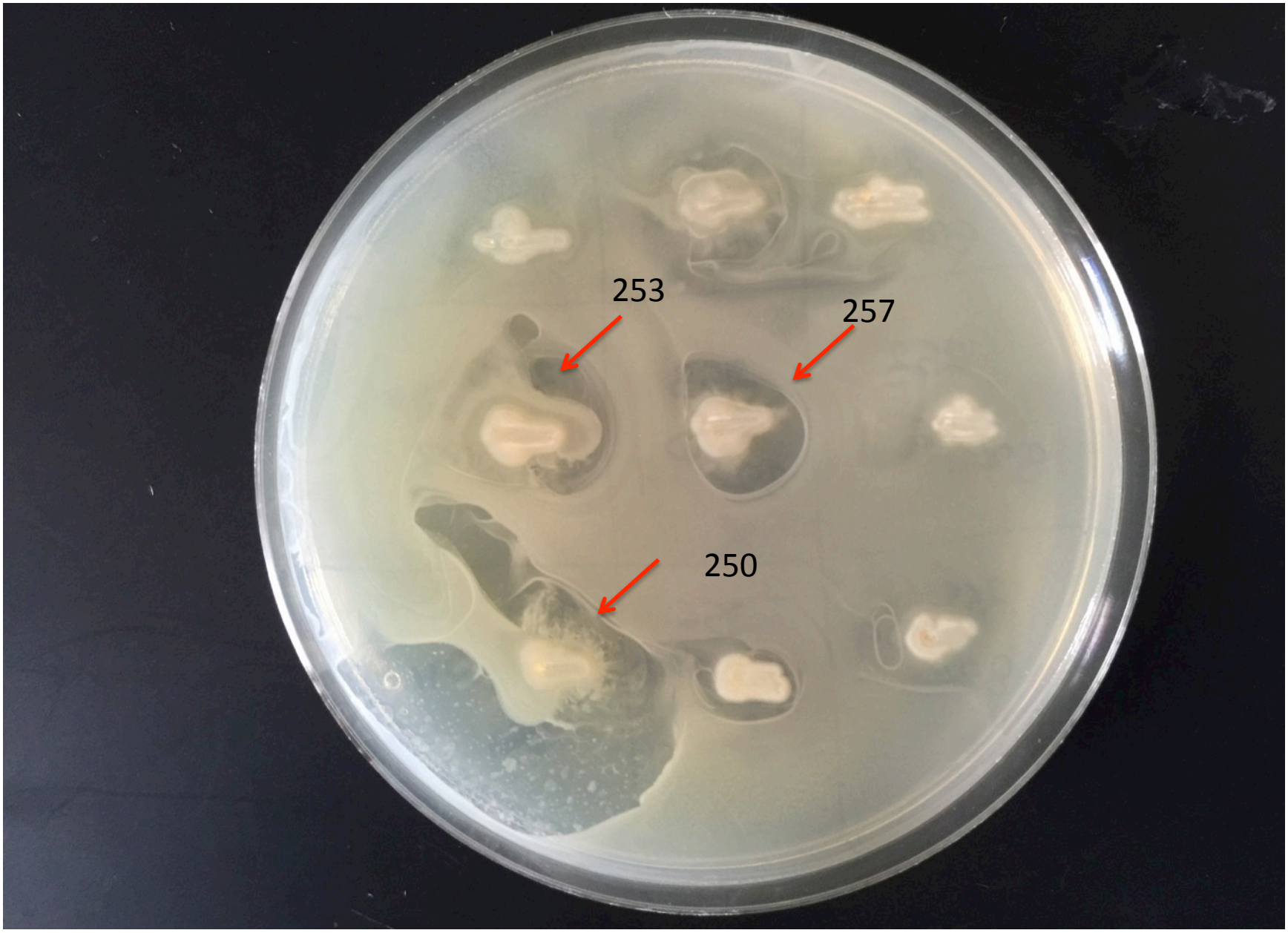
Research Objectives

- Determine the necessity of antibiotic application according to environmental conditions.

- Develop biological control materials as alternatives to antibiotics.

Isolate bacteria associated with apple flowers




253
257
250

Field test of biological control against fire blight

Fire blight control efficacy in 2017 trial Hamden, CT

Treatment	Water	Streptomycin	Bacteria 1	Bacteria 2
Disease incidence	66±9 %	19±5%	23±7%	24±9%

Take home messages

- Transportation of plant materials facilitates dispersion of plant diseases.
- The occurrence of plant diseases is affected by environmental factors.
- Plant “probiotics” (biological controls) can compete and inhibit pathogen growth and control plant diseases.

Quan Zeng
Department of Plant Pathology and Ecology
123 Huntington Street
P. O. Box 1106
New Haven, CT 06504

Phone: 203.974.8613
Email: quan.zeng@ct.gov
Website: www.ct.gov/caes
twitter Quan Zeng @oldkayak