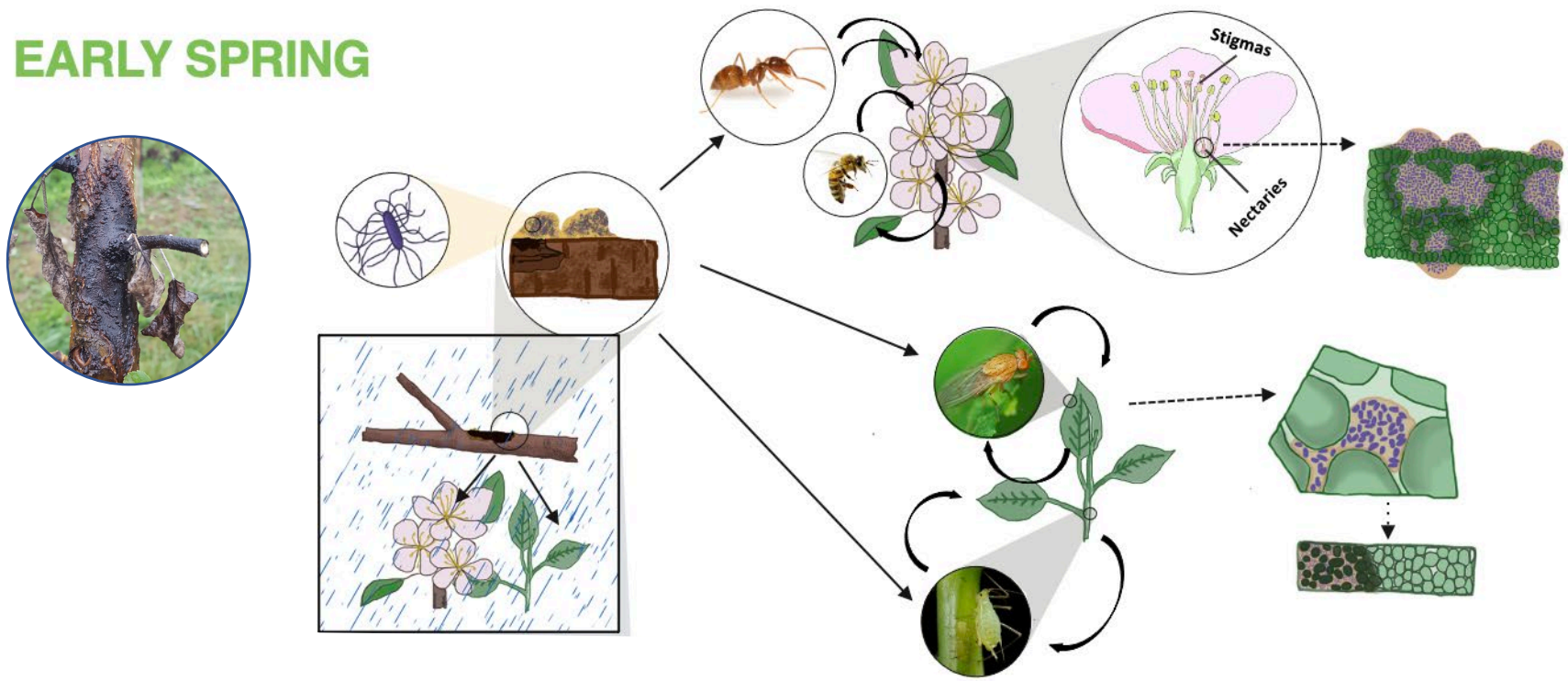
Erwinia amylovora survival in cankers: What do we know?

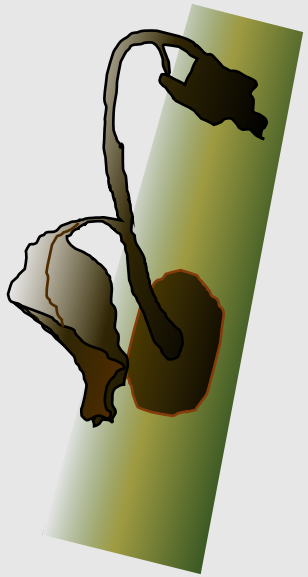
Ricardo Delgado Santander

Fatemeh Khodadadi, Christopher L. Meredith, Željko Rađenović, Jon Clements, Srđan G. Aćimović

Canker Development



Cankers and Fire Blight Outbreaks



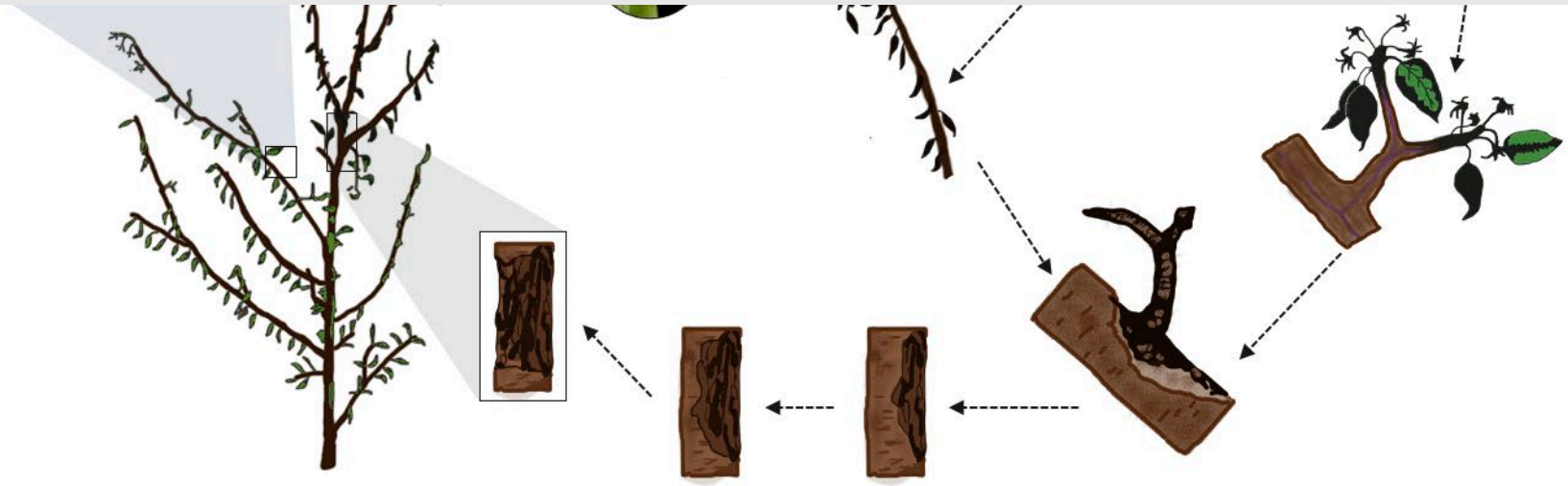
- **Reservoirs** of the pathogen
- Enable **winter survival**
- *Ea* **inoculum sources** in spring

→ Does *Ea* survive in all the cankers?

→ Which factors contribute to *Ea* survival?

→ Do *Ea* populations keep constant over time?

AUTUMN
WINTER



SUMMER

Factors Affecting *E. amylovora* Survival in Cankers

- Irrigated vs non-irrigated apple trees
- Non-irrigated pear and Asian pear trees
- Shoot inoculation in June to obtain cankers
- Cankers harvested in Jul, Oct, Jan, Apr
- Two experimental repeats:

  → **2016:** Extreme Drought Conditions

  → **2017/2018:** Colder/Wetter weather

Host species	Apple (*Malus pumila* Mill.)	Pear (*Pyrus communis* L.)	Asian pear (*Pyrus pyrifolia* Nakai)
Host cultivar (resistance to Fire blight)	'Cortland'	'Bartlett'	'Hosui'
	'Cameo'	'Bosc'	'Shinko'
	'Honeycrisp'		'Yoinashi'

Factors Affecting *E. amylovora* Survival in Cankers

Logistic Regression Analysis

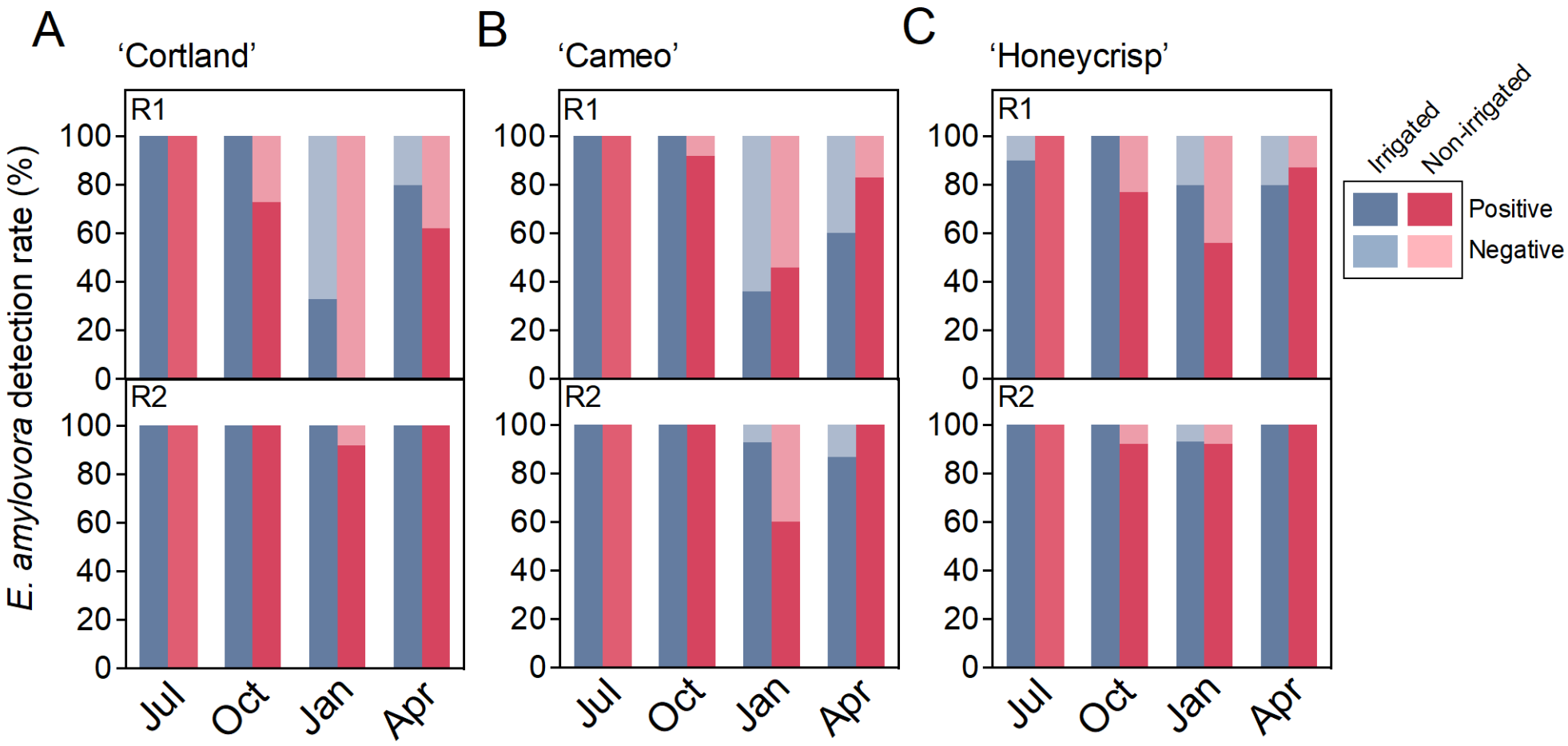
→ Variables increasing the chances of detecting *Ea* in cankers

- Year period (July > October > April > January)
- Wetter & Cold weather > Drought
- Irrigation > non-irrigation
- Host species/cultivar

Factors Affecting *E. amylovora* Survival in Cankers

2016
DROUGHT

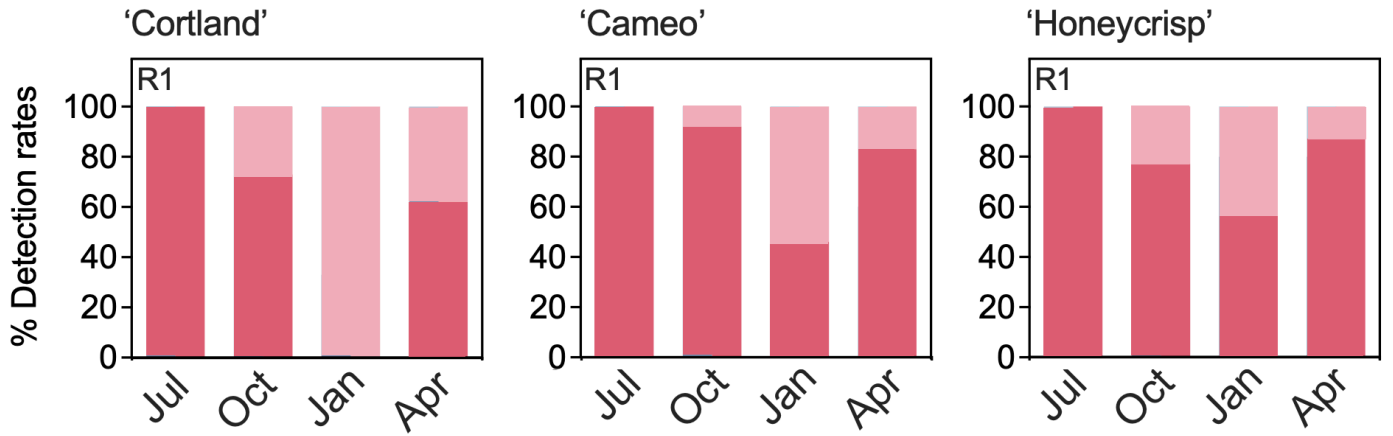
2018
NORMAL
WEATHER



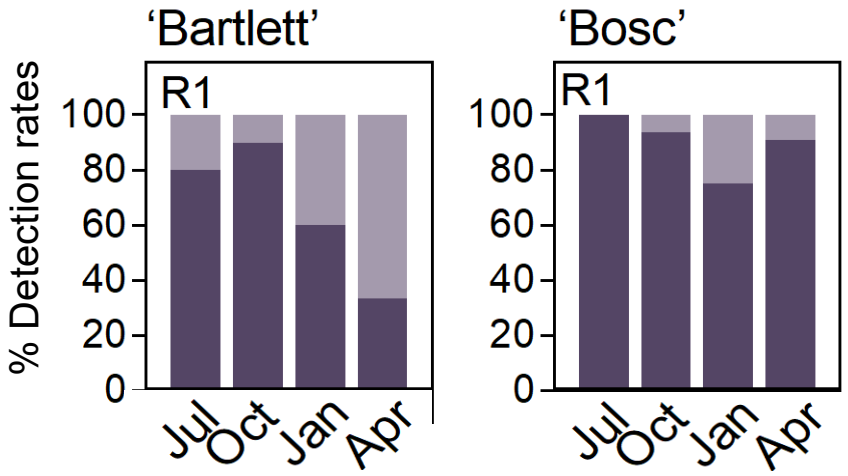
Factors Affecting *E. amylovora* Survival in Cankers

2016
DROUGHT CONDITIONS

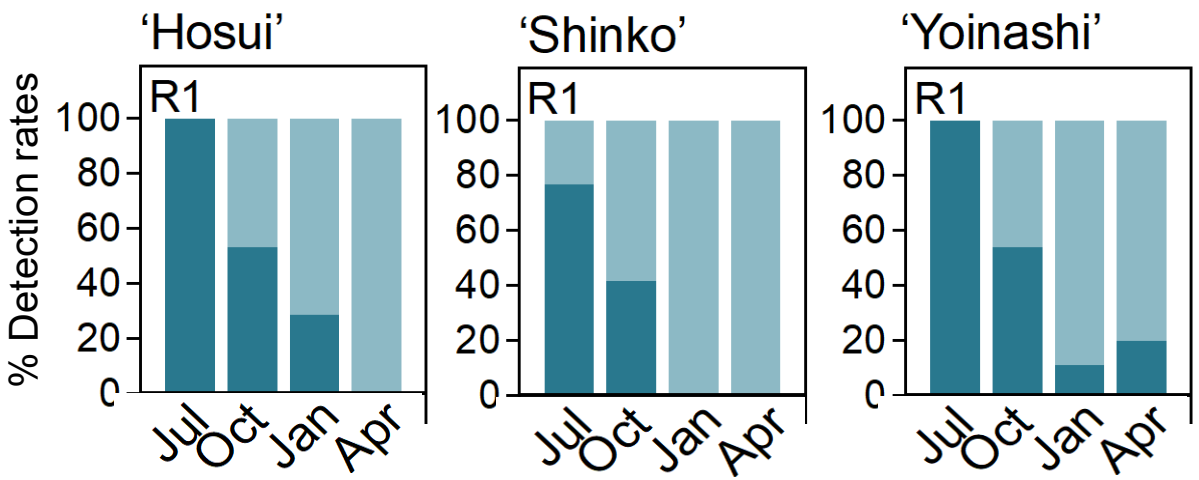
Apple



Pear



Asian Pear



Factors Affecting *E. amylovora* Survival in Cankers

Logistic regression Analysis

→ Variables increasing the chances of detecting *Ea* in cankers

- Year period (July > October > April > January)
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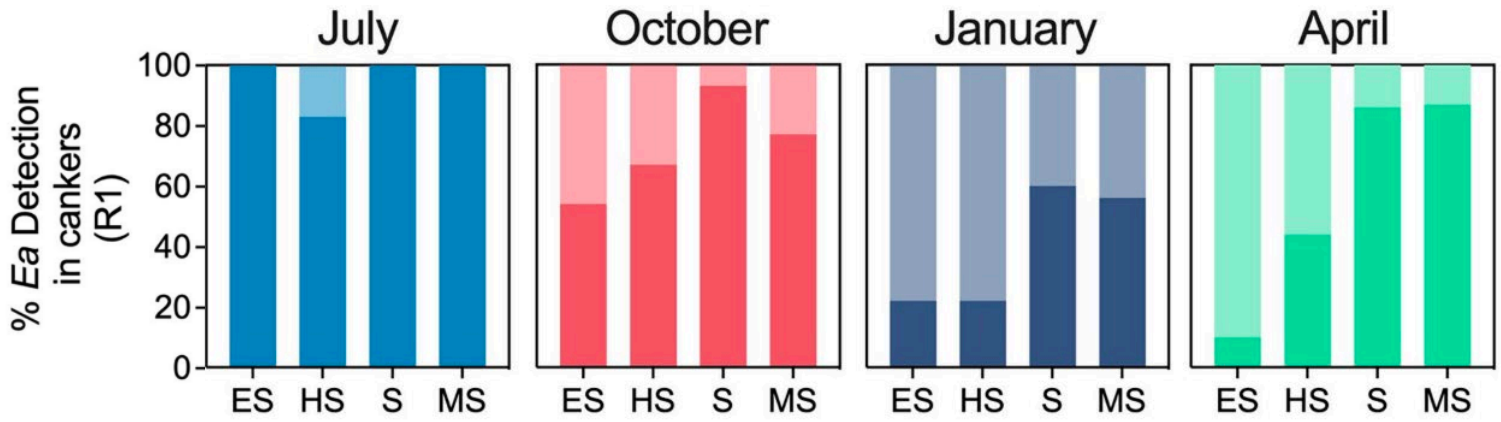
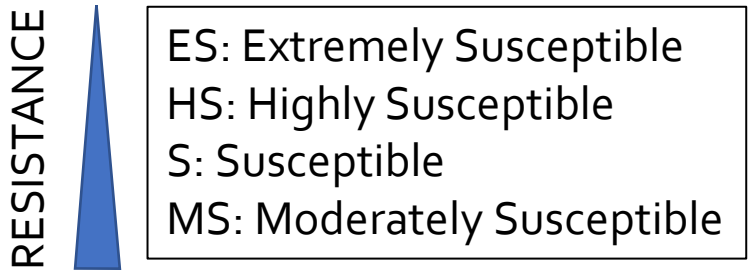
- Irrigation > non-irrigation
- Host species/cultivar
- **Host resistance: More resistant > More susceptible**

2016





Factors Affecting *E. amylovora* Survival in Cankers

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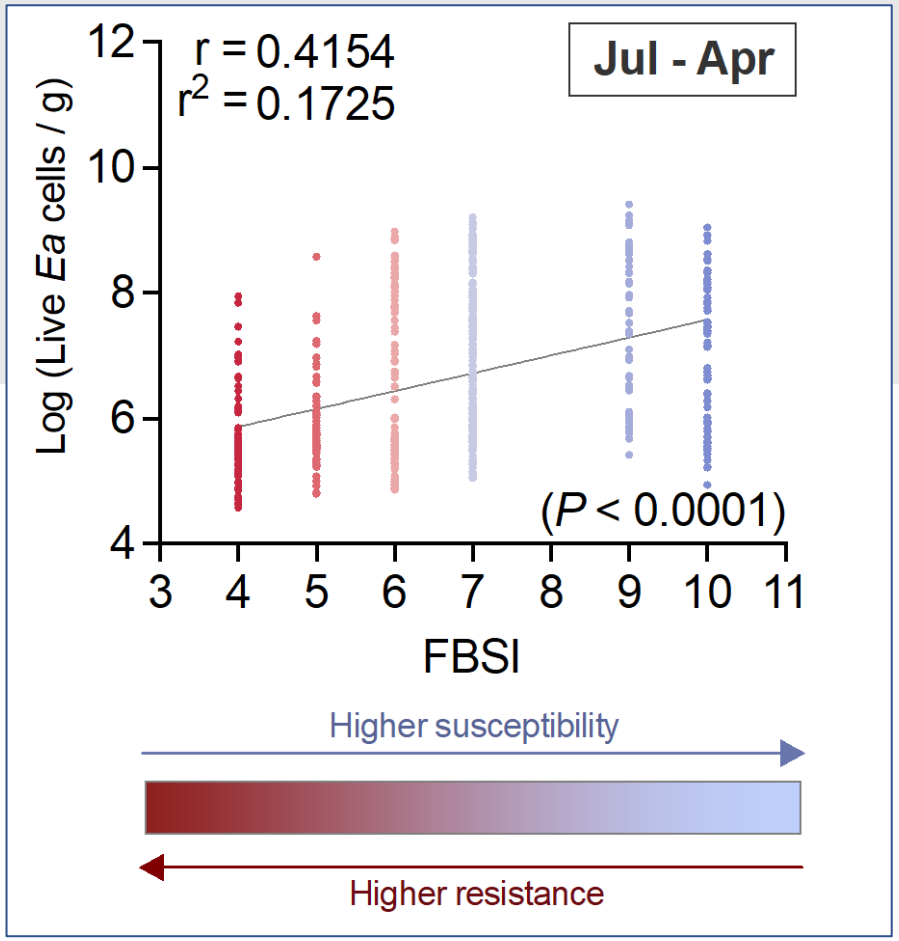
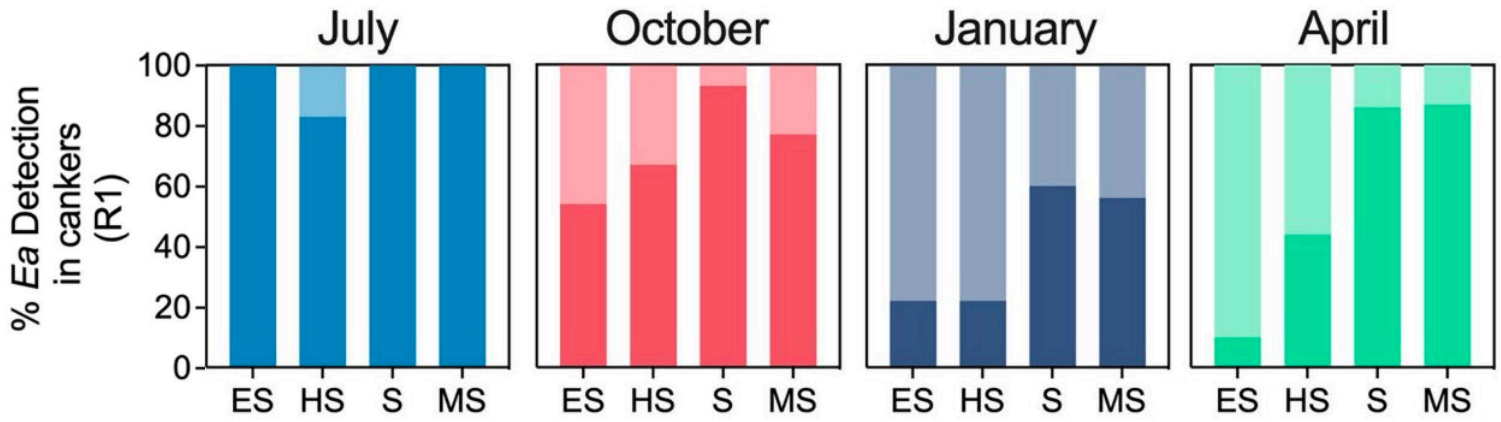


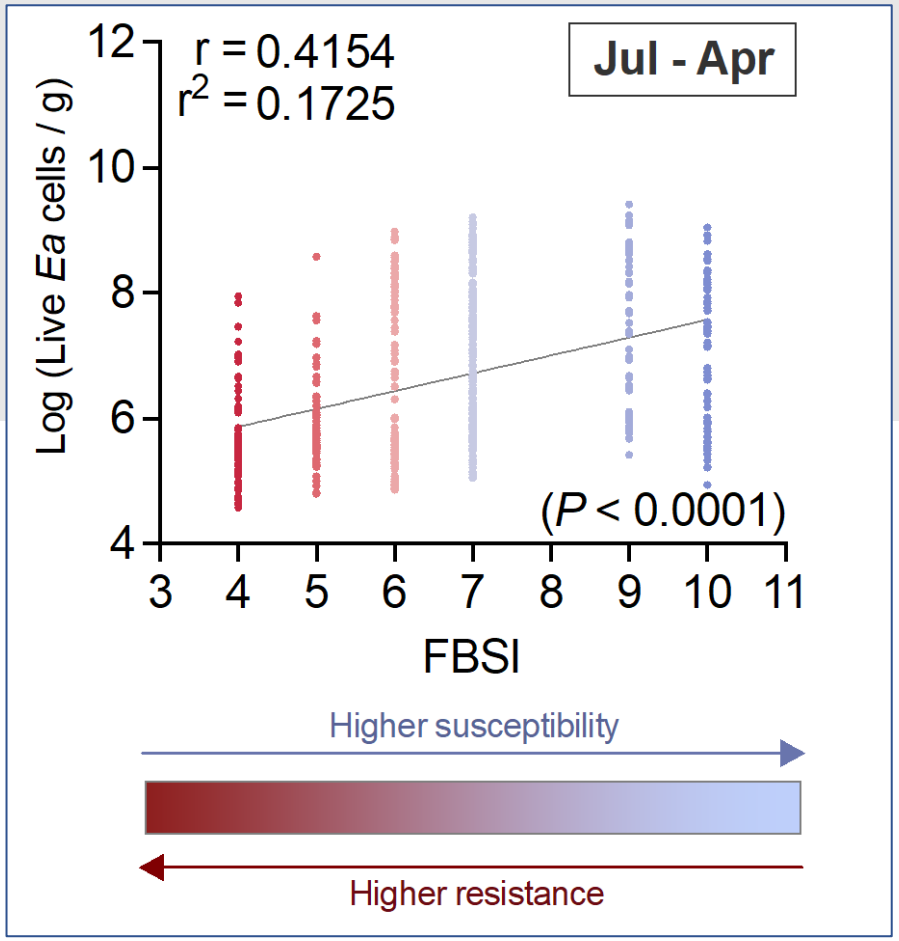
2016



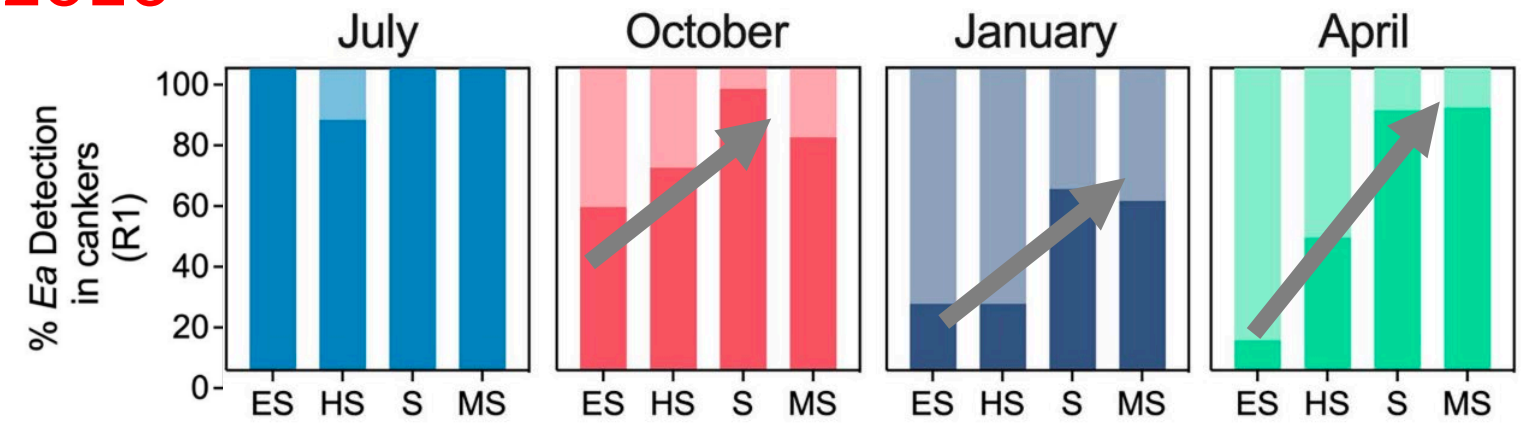
Factors Affecting *E. amylovora* Survival in Cankers

- *E. amylovora* overwinters better in cankers of more resistant hosts
- The populations of the pathogen tend to be higher in more susceptible hosts
- These results can be explained by:

  → *Ea* growth inhibition by the host
  → Speed of symptom progression
  → Differential effect of Temp. on starving and feasting cells

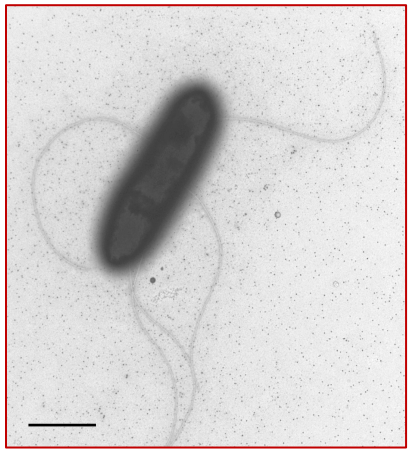


2016

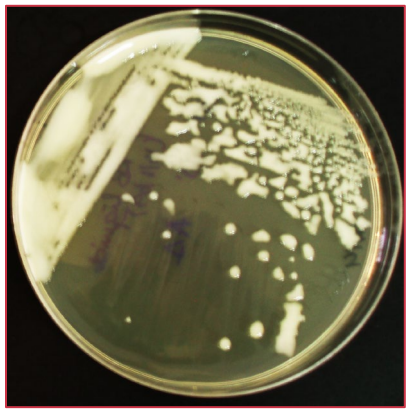


Erwinia amylovora physiology

E. amylovora is a **NON-OBLIGATE** pathogen → **ADAPTATIONS**



- Saprophyte → Able to feed on nutrients obtained from the host
  → No special nutritional requirements → Grows on a wide range of organic materials



- Mechanisms to cope with starvation → Survival in the environment

Erwinia amylovora survival

The effects of temperature vary depending on *Ea* nutritional conditions

Nutrient-Rich environments

(Host's tissues, culture media)

→ Range of temperatures allowing *Ea* growth (appr. 39.2 F – 96.8 F)

→ Optimal growth temperature (appr. 82.4 F)

Nutrient-Limiting environments

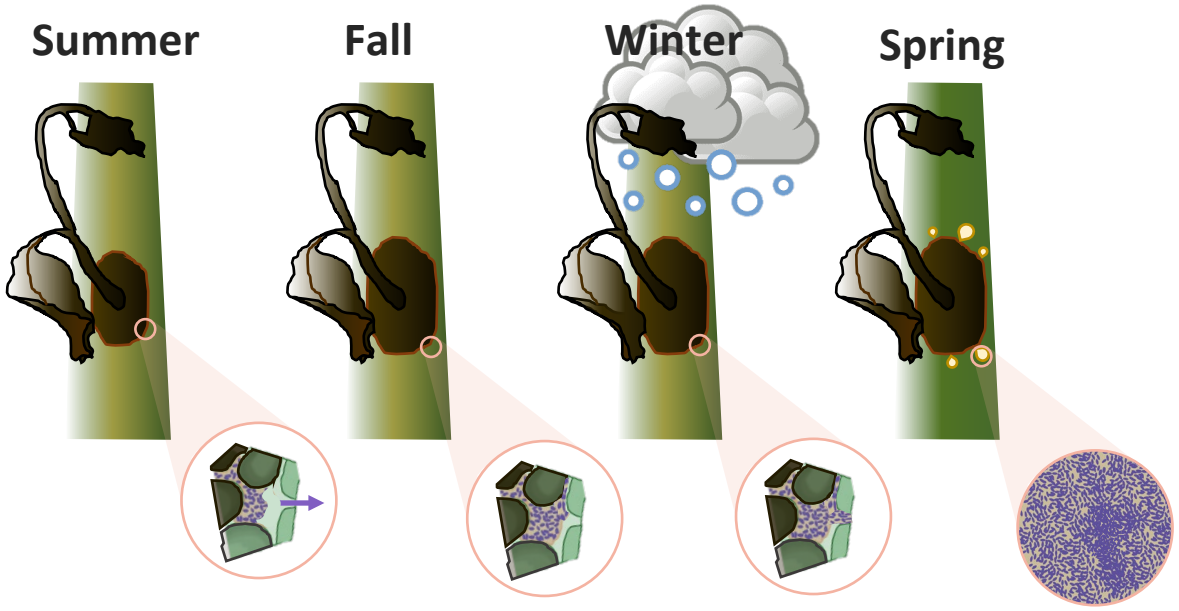
(Dead tissues, non-host environments)

→ Survival under starvation conditions improved at 39.2 F – 68 F.

→ Higher death rates at ≥ 82.4 F and < 39.2 F

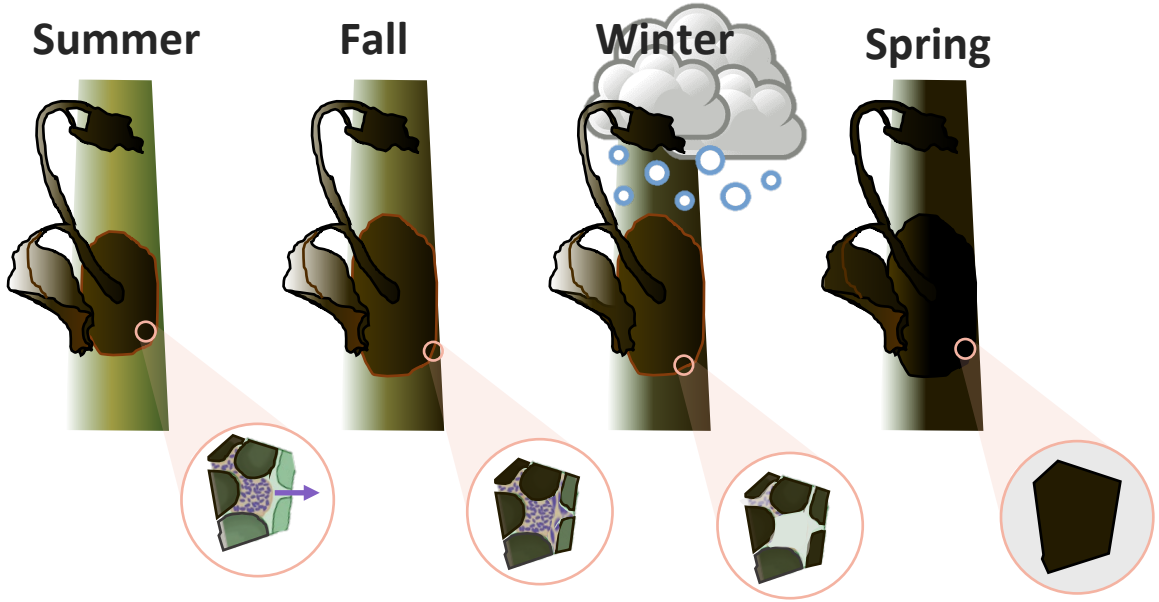
Erwinia amylovora survival

Resistant Host



1. Available healthy tissue → Host slows down infection
2. Infection progresses through Summer – Fall, while environmental conditions are favorable
3. In winter, there's still healthy plant material available, and *Ea* cells get trapped within healthy tissues.
4. In Spring, with the host's renewed growth, *Ea* cells continue infecting the available tissues.

Highly Susceptible Host



1. Available healthy tissue → *Ea* spreads quickly
2. Infection progresses through Summer – Fall, while environmental conditions are favorable. Compared to resistant hosts, many *Ea* cells stay within necrosed tissues
3. In winter → Low/freezing temperatures kill *Ea* cells
4. In Spring → No detection of *Ea* in cankers

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Fire blight resistance, irrigation and conducive wet weather improve *Erwinia amylovora* winter survival in cankers

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