Invasive Ambrosia Beetle Conference
The Situation in California
August 12 – 14, 2012

Meeting sponsored by:

The Hofshi Foundation

University of California, Riverside

UC Center for Invasive Pest Research

The Huntington Botanical Gardens

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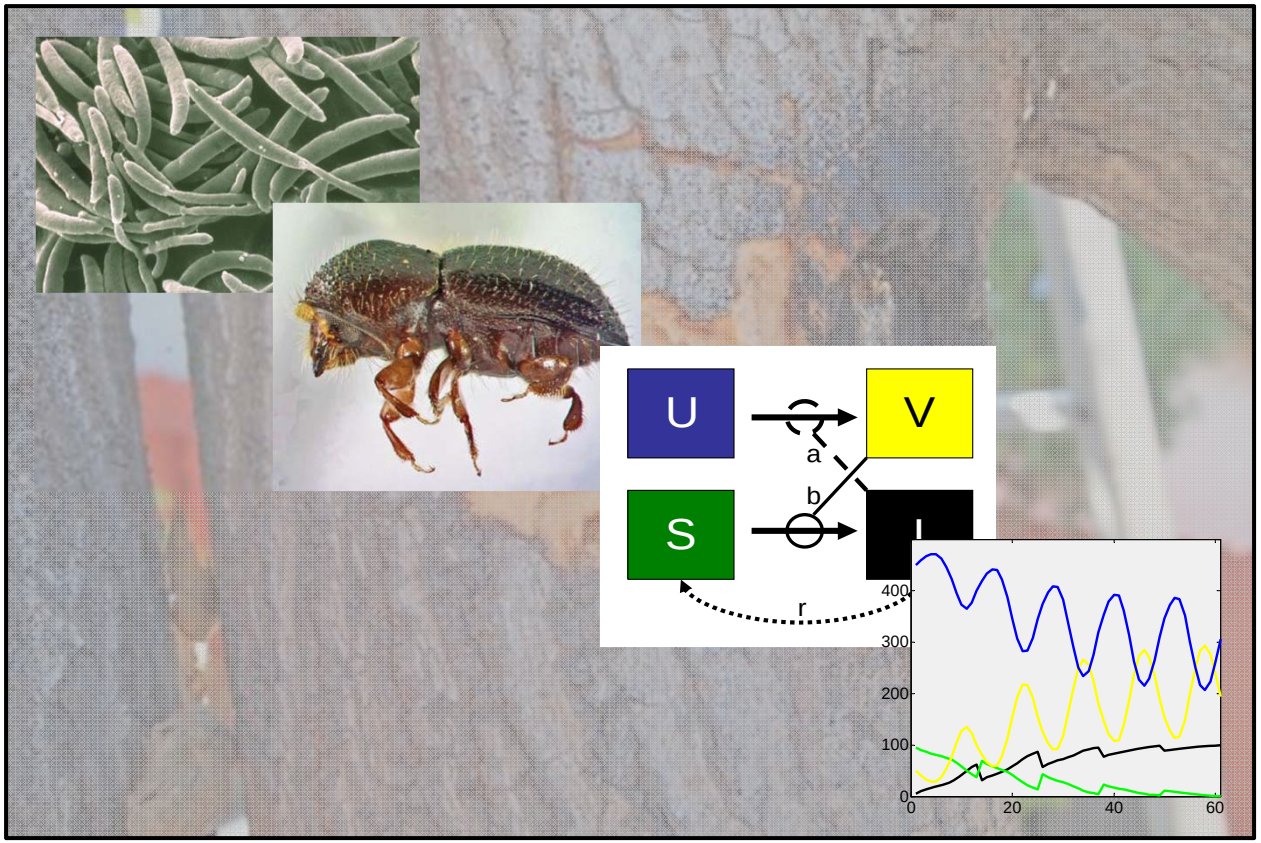
Session 6

Invasion Epidemiology

Invasion biology of vector-borne diseases: factors that drive outbreaks



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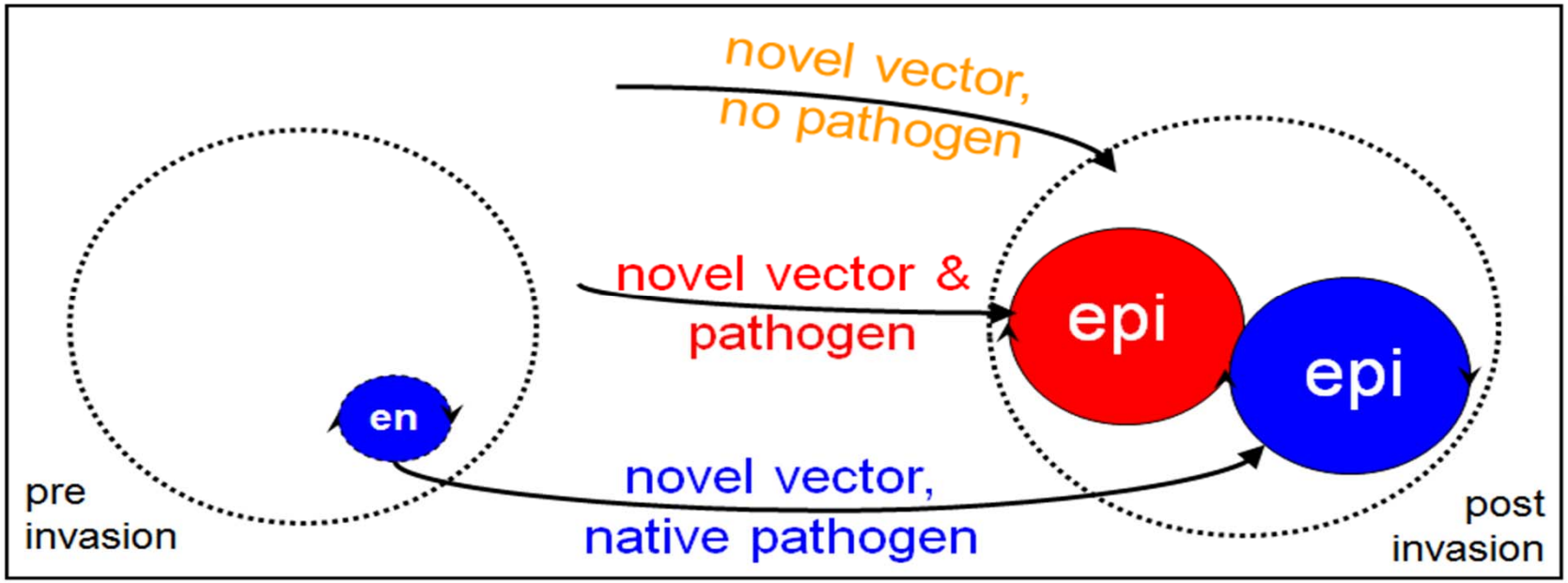
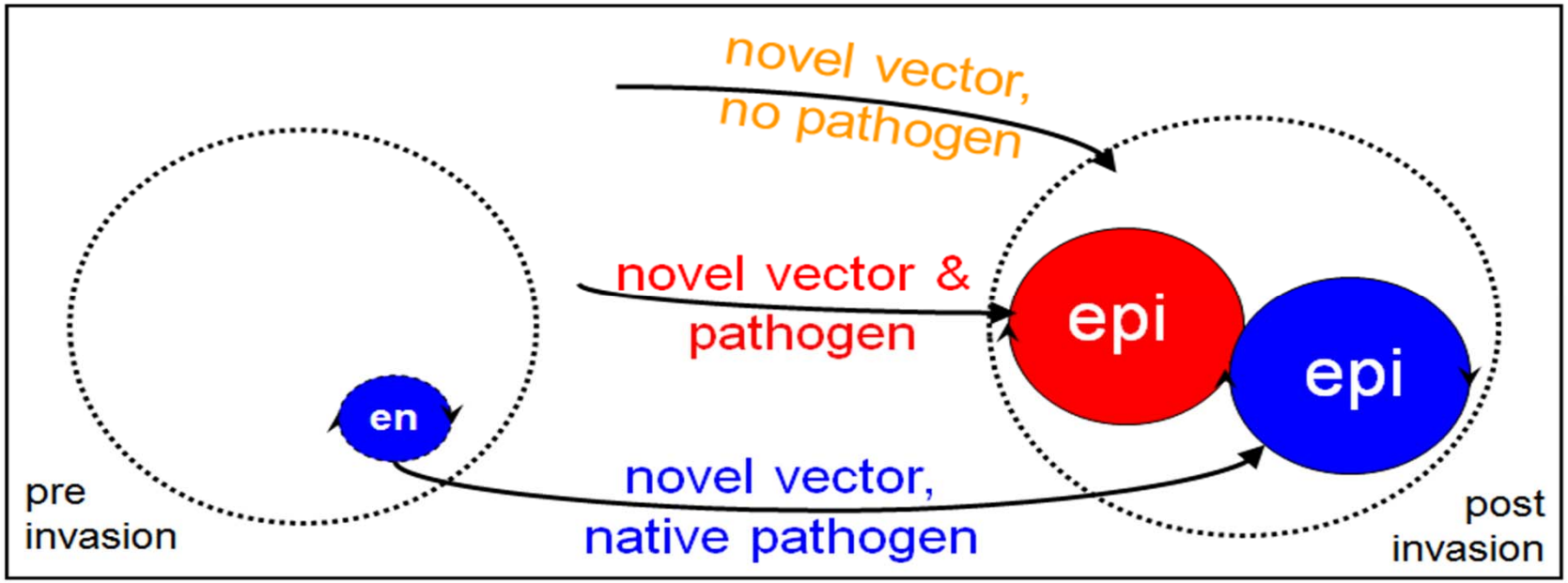
Outcomes of vector invasion



- Novel vector, no pathogen (ACP [until 2012])
- Novel vector & novel pathogen (PSHB & *Fusarium*)
- Novel vector, native pathogen (GWSS & *Xylella*)

Outcomes of vector invasion



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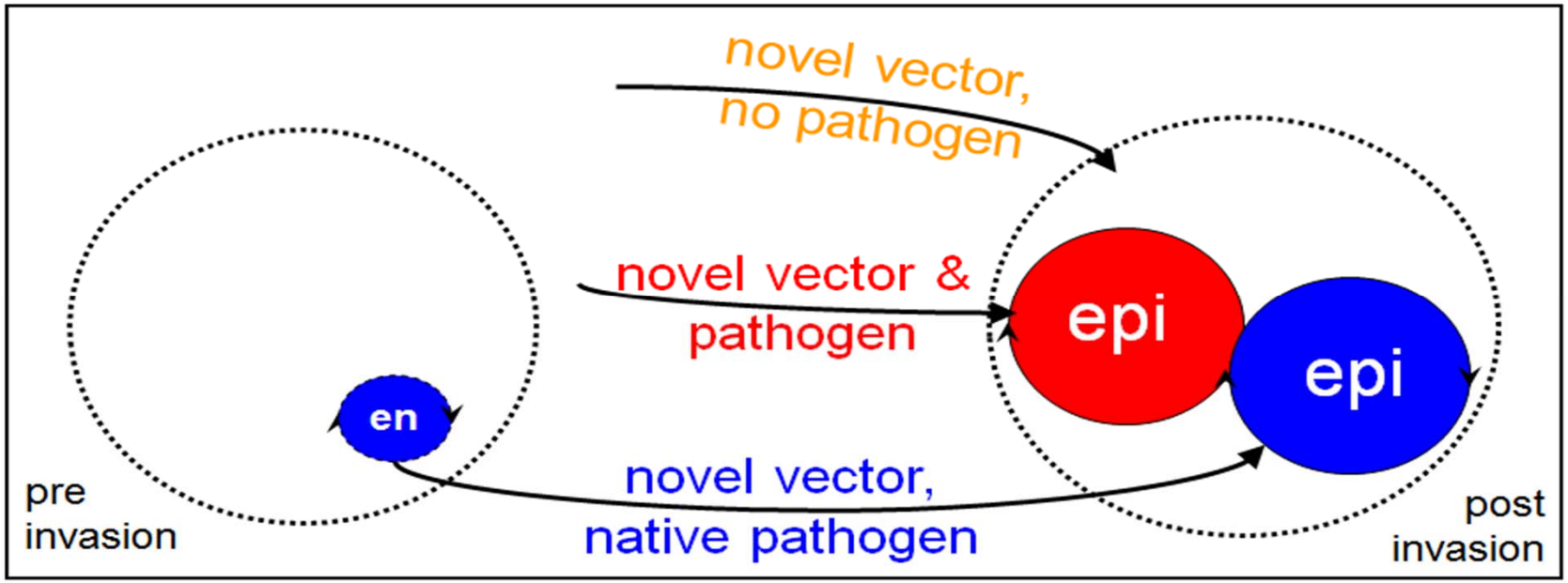
what's special about invader?

Outcomes of vector invasion



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Pace of outbreak

Factors affecting vector-borne disease outbreaks

- Transmission efficiency
- Vector behavior
- Vector ecology
- Pathogen incubation and latency
- Host range/diversity
- Pathogen strain
- Climate
- Seasonality

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1. Transmission efficiency

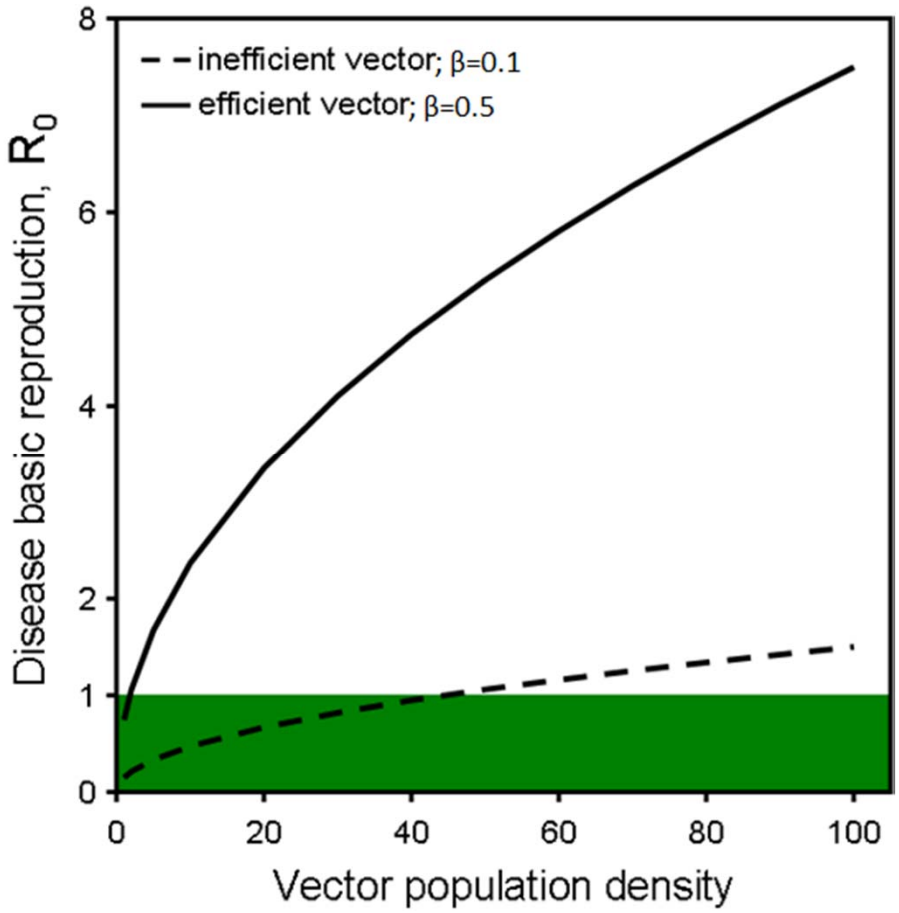
R_o is a measure of pathogen net reproductive rate

-threshold quantity (>1 for outbreak)

Vector abundance contributes to outbreaks

High transmission efficiency contributes to outbreaks

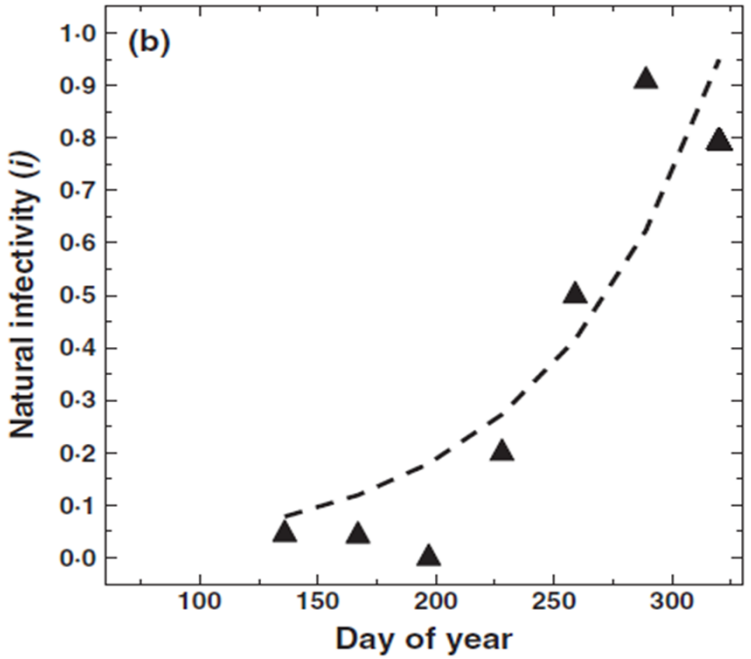
-vector control, alone, may be insufficient to limit spread by efficient vector

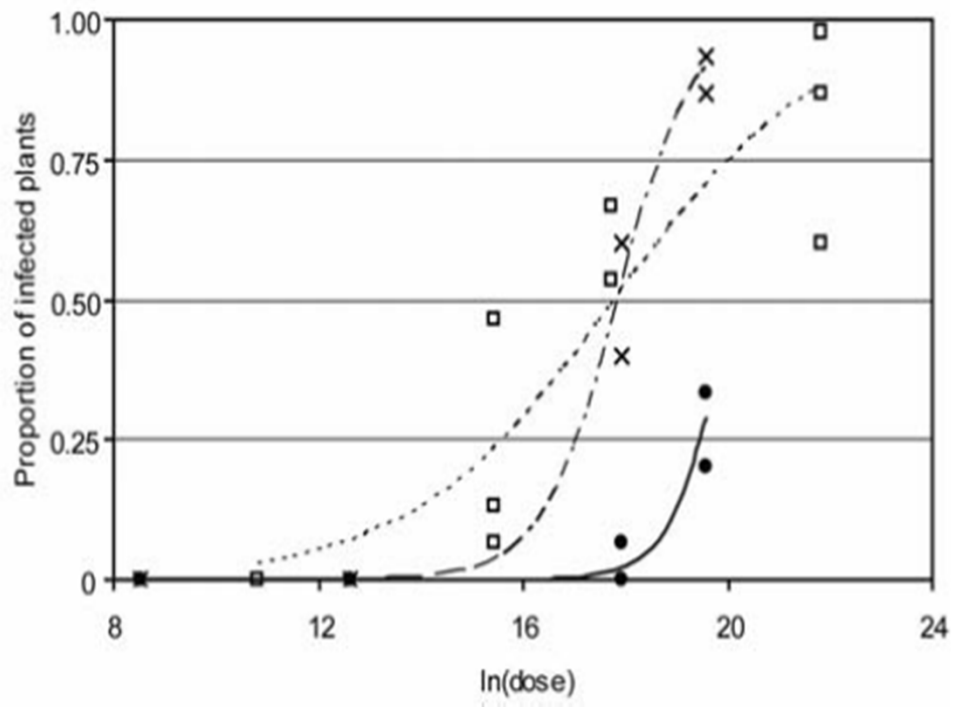


Natural infectivity

-proportion of infectious vectors

-extremely high for ambrosia beetles?





Infective dose

-inoculum supply required for chronic disease

-size of beetle mass attack?

2. Vector preference for host infection status

Infections induce phenotypic changes in hosts

Changes frequently illicit responses from vectors

-visual and/or olfactory cues

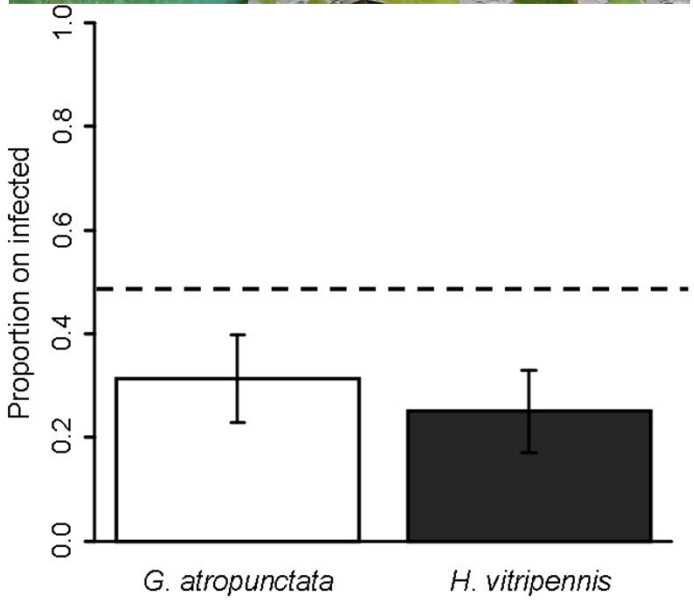
Wide range of responses by vectors

-preference for infected

-discrimination against infected

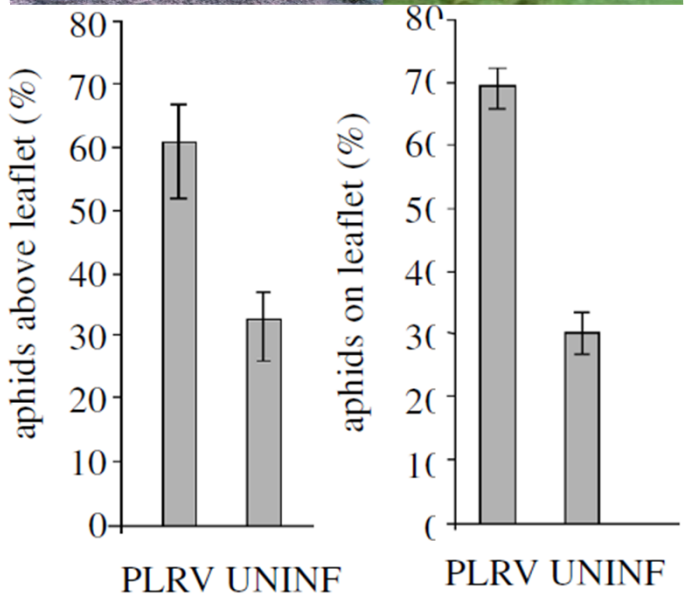
-initial attraction to, but then repelled by infection

Sharpshooters & Pierce's disease



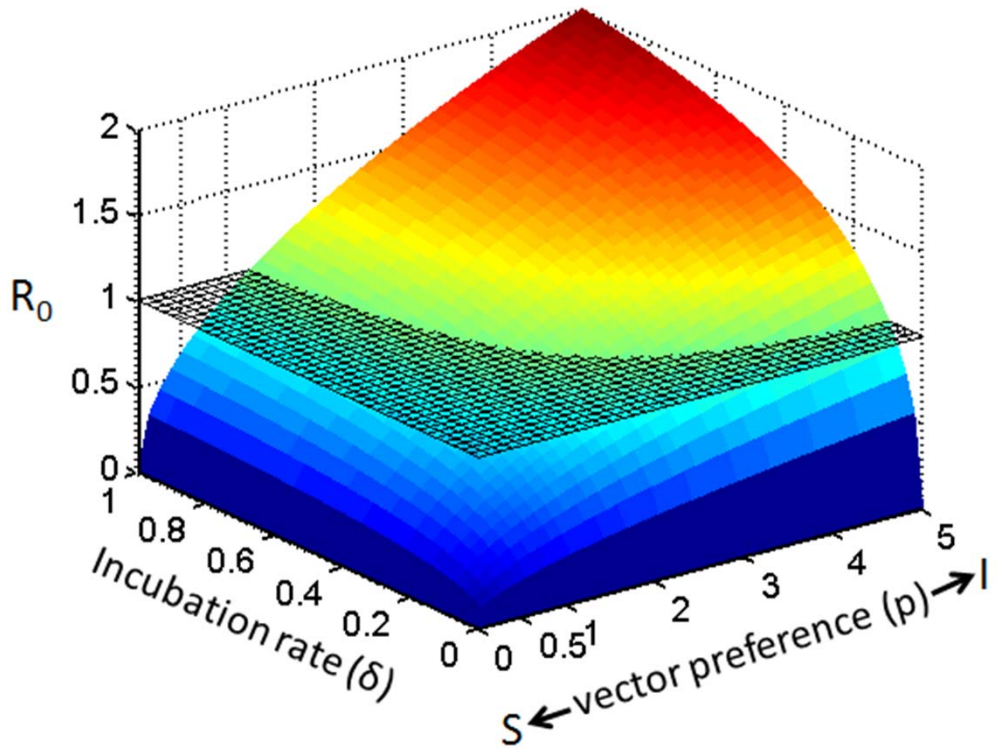
-more likely to orient to and feed on healthy plants

Green peach aphid & potato leafroll virus



-more likely to orient to infected plants

Vector preference affects pathogen spread



Ambrosia beetles attracted to stressed/infected trees

-significant for maintaining infectivity of beetles?

3. Pathogen incubation and latency

latent period = time to infectiousness

incubation period = time to symptoms

Differ among:

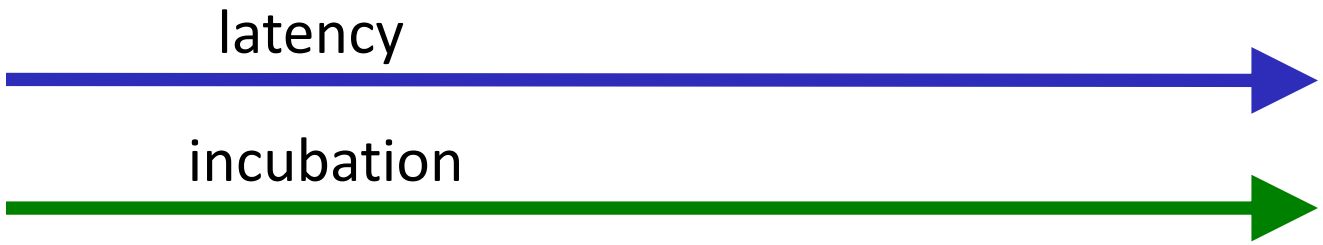
-pathosystems

-host species or cultivars

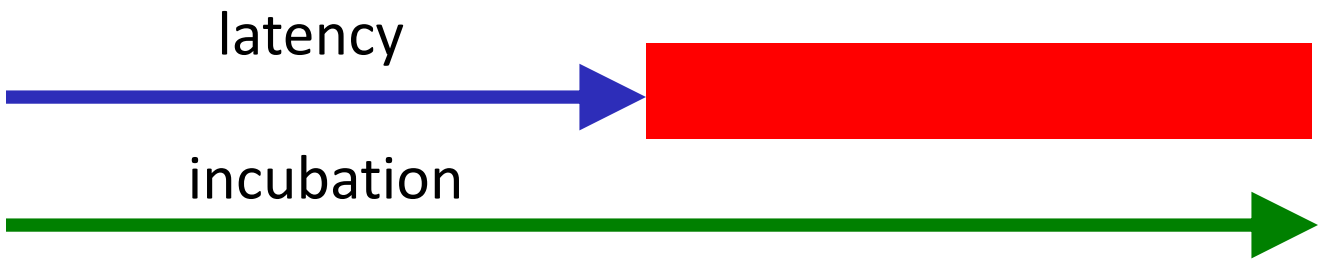
-pathogen strains

-climatic conditions

Best case scenario: symptoms manifest at or before infectivity



Worst case scenario: symptoms manifest much later than infectivity



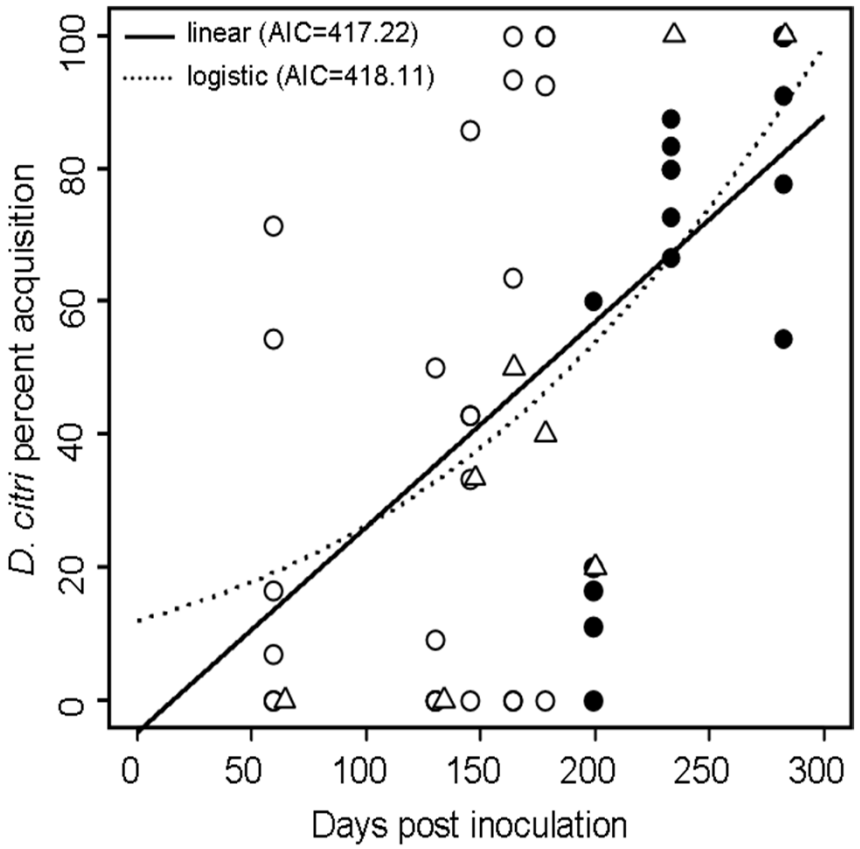
-limits the effectiveness of host removal (roguing)

Huanglongbing & Asian citrus psyllid transmission

Symptoms manifest after > 6 mo (2+ years in the field)

Trees infectious after < 2 mo

Substantial potential for spread before roguing is possible



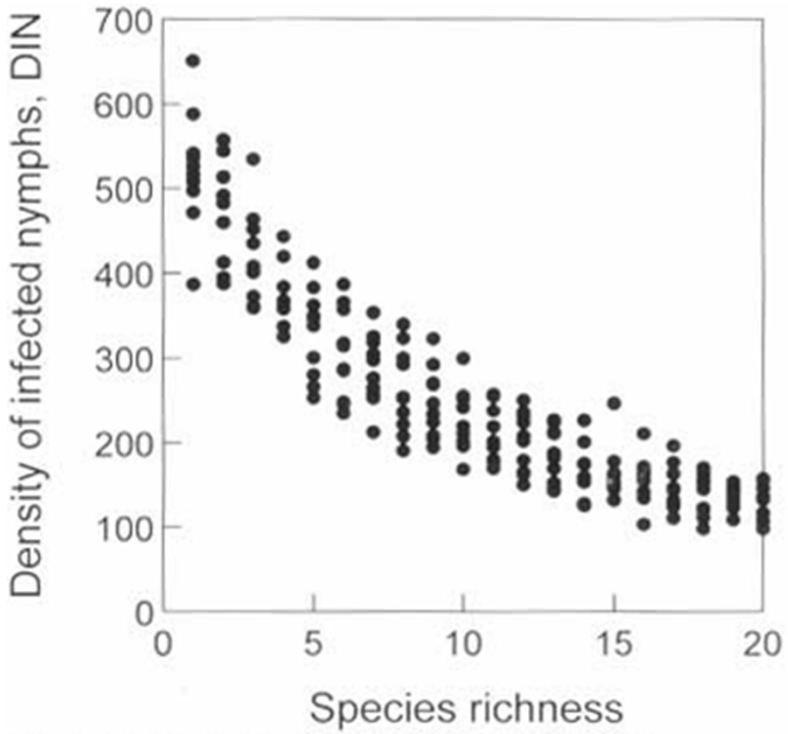
4. Host range and diversity

For generalist pathogens, disease dynamics depend on host community composition

Different species vary in their reservoir competence (i.e. ability to support the pathogen)

1. dilution effect

2. hosts resistance vs. tolerance



"Dilution effect"

Diverse communities have lower risk of disease spread

-Lyme disease

-West Nile virus

Diversity reduces the prevalence of highly competent "weedy" species

-e.g., white-footed mouse

Some generalist plant pathosystems share these basic features

Host resistance vs. tolerance

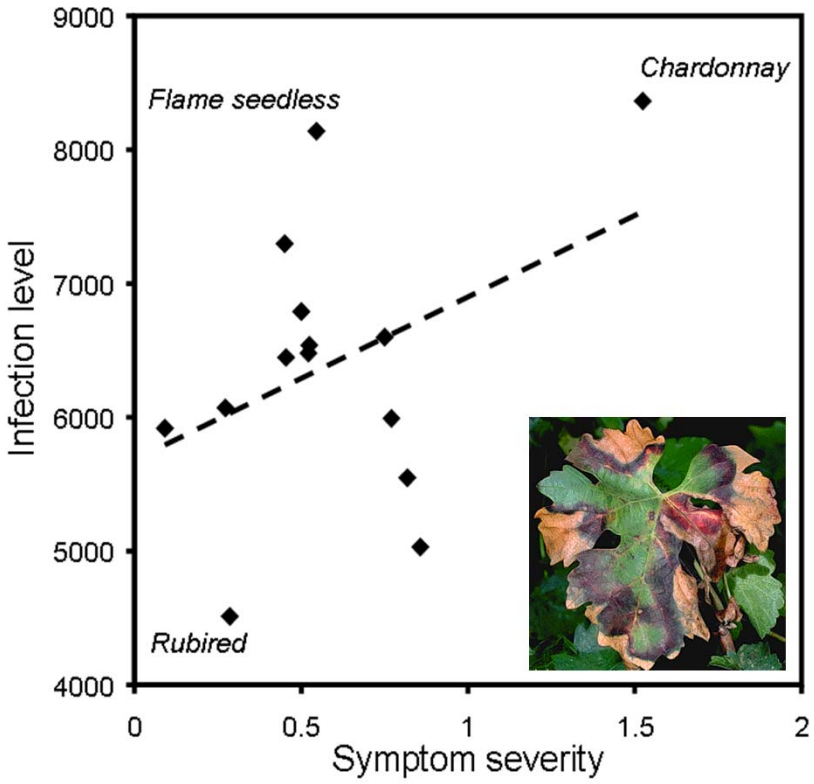
Species or cultivars frequently differ in disease severity

Two potential mechanisms:

resistance = reduced infection level

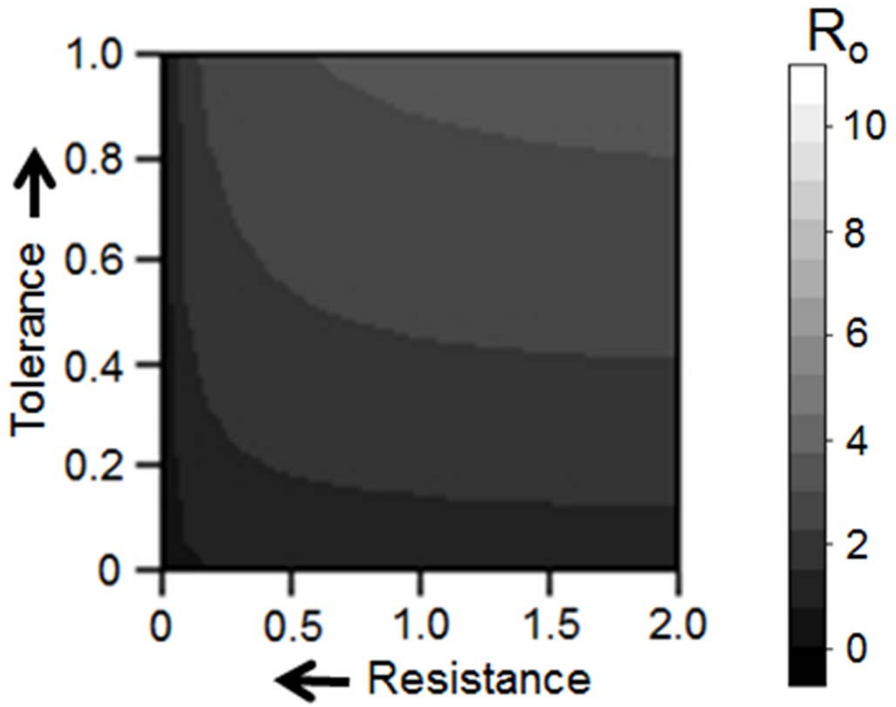
tolerance = reduced symptom severity despite infection

Relative resistance vs. tolerance may be epidemiologically important



Resistance reduces pathogen spread, tolerance increases it

-asymptomatic ”carriers” as act pathogen sources



Significance for ambrosia beetles and their symbionts?

-long-lived , tolerant hosts may be important reservoirs

Natural infectivity

Infective dose/mass attack size for chronic infection

Host range

Beetle preferences

- -species/cultivars
- -infection status

Host resistance or tolerance to Fusarium infection

- -latent period
- -incubation period