

# Plant Stress and *Phytophthora ramorum* Infection

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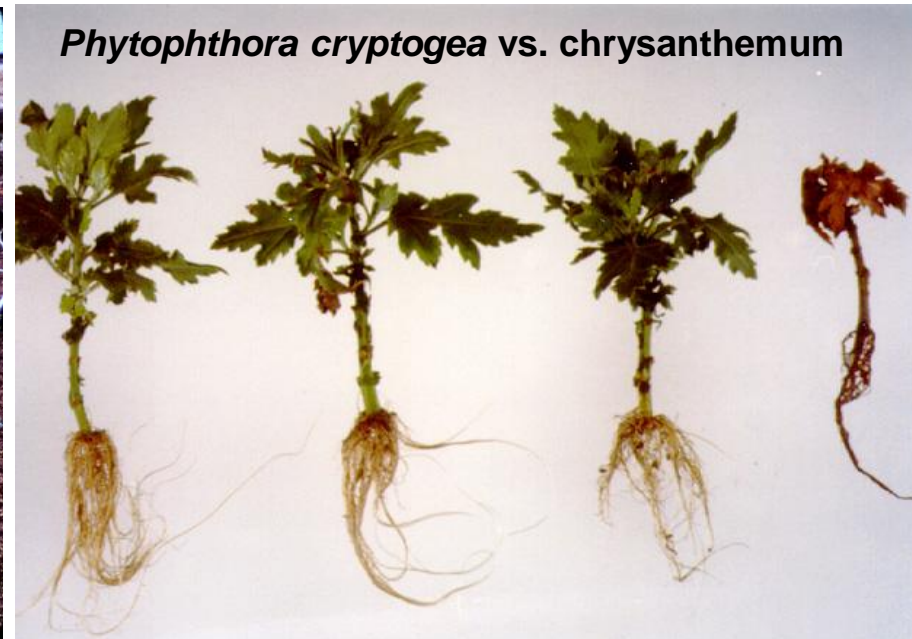
# Root stress predisposition to *Phytophthora* diseases

- Episodes of root stress (water deficit, anoxia, salinity) induce susceptibility to *Phytophthora* root and crown rots
- Stress levels occur commonly in agriculture
- Common responses to these stresses – systemic elevation of abscisic acid (ABA)



Water stress predisposition to *Phytophthora* in safflower

(courtesy J.M. Duniway and J.D. MacDonald)



Control      Salt      Control      Salt

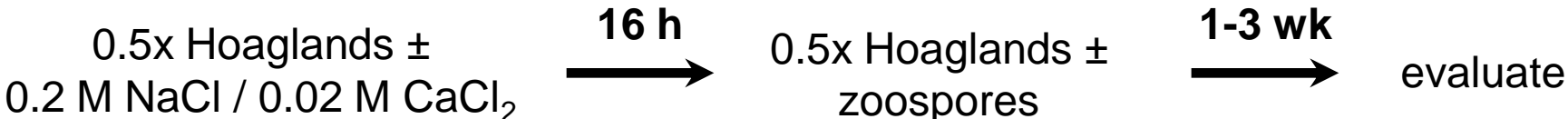
←—————→      ←—————→  
non-inoculated      inoculated

# ***Phytophthora ramorum* and nursery ornamentals**

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- **Role of root infections in disease cycle?**  
*(Jennifer Parke, Nina Shishkoff)*
- **Problem of cryptic, or asymptomatic, infections**
- **Episodic root stress and *Phytophthora* – soil moisture extremes and *P. cryptogea* in *Rhododendron***  
*Blaker and MacDonald (1981) Phytopathology 71:831*

# Nursery ornamentals, root stress and *P. ramorum*



*Rhododendron* hybrid Cunningham's White

*Viburnum tinus* cv. Spring Bouquet

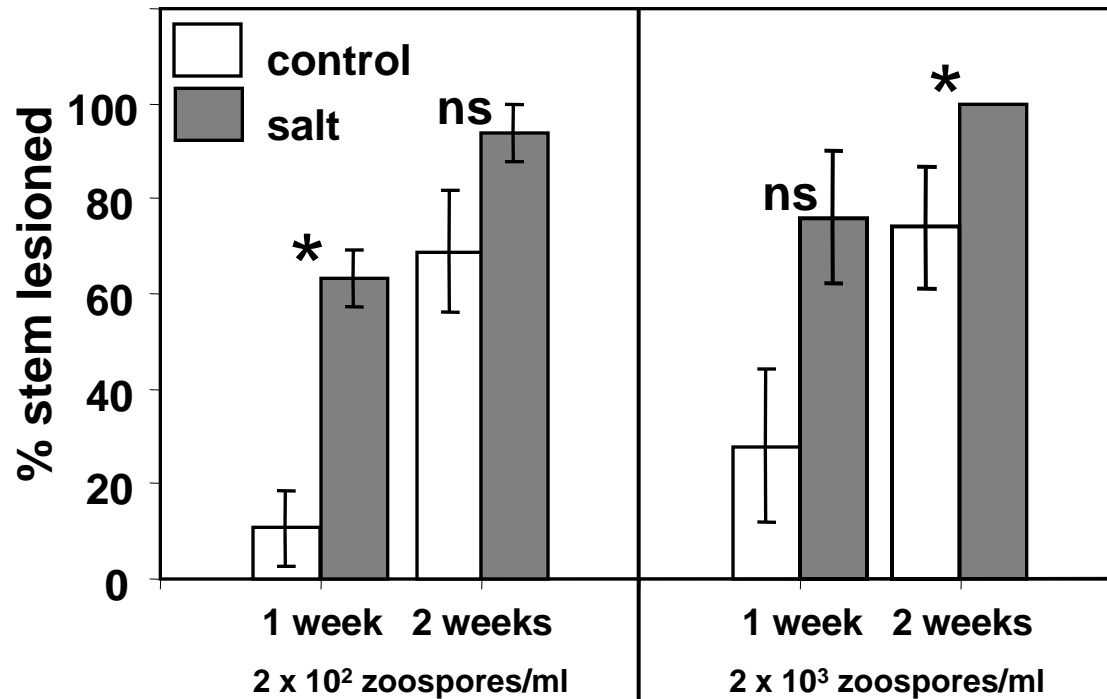


Control Salt Control Salt  
non-inoculated inoculated

Control Salt  
inoculated

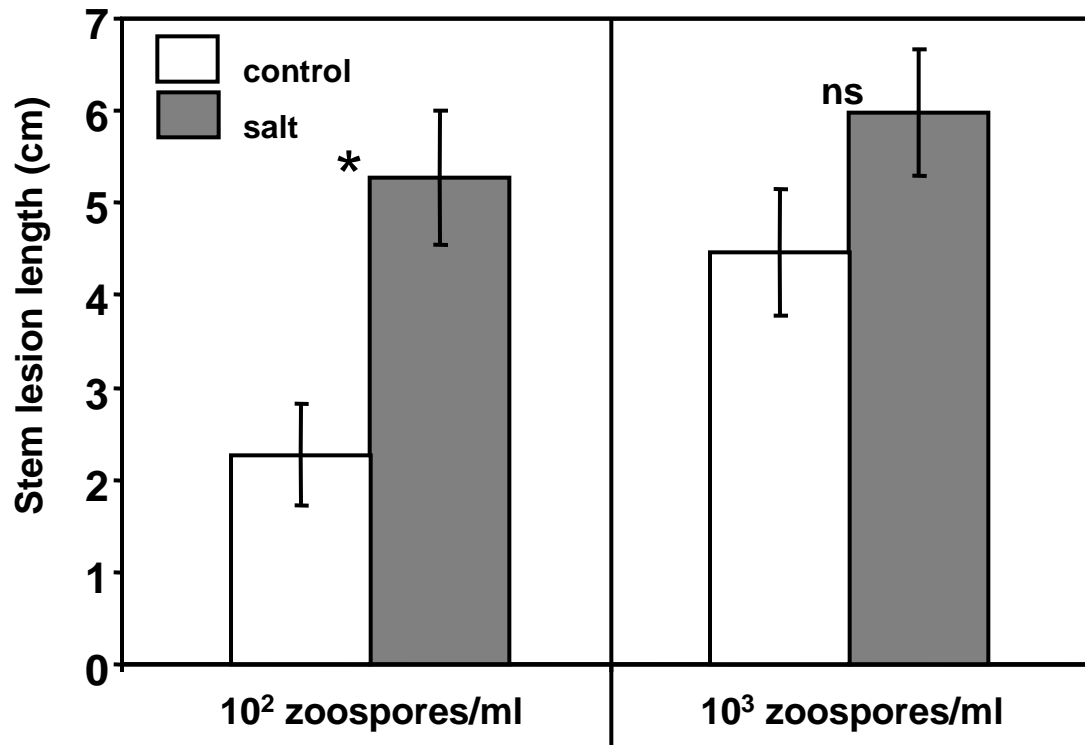
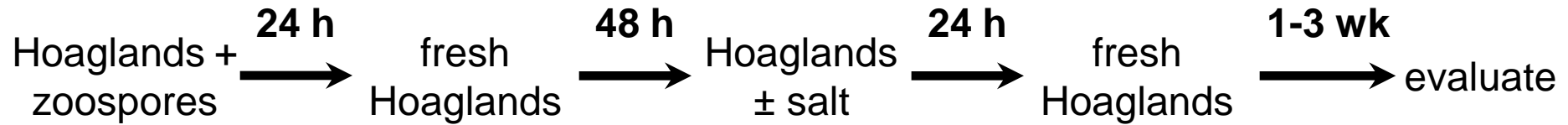
1 week post-inoculation

# Predisposition in *Rhododendron* to *P. ramorum*



- infections in “nonstressed” plants catch up to “stressed”
- inoculum density is important to see predisposition effect

# Predisposition in Rhododendron to *P. ramorum*



- a postinfection stress episode can significantly enhance disease and symptom development

# Abscisic acid in plant stress responses and disease

abiotic stress



osmoadaptation,  
water balance

duration & intensity



altered gene and protein expression

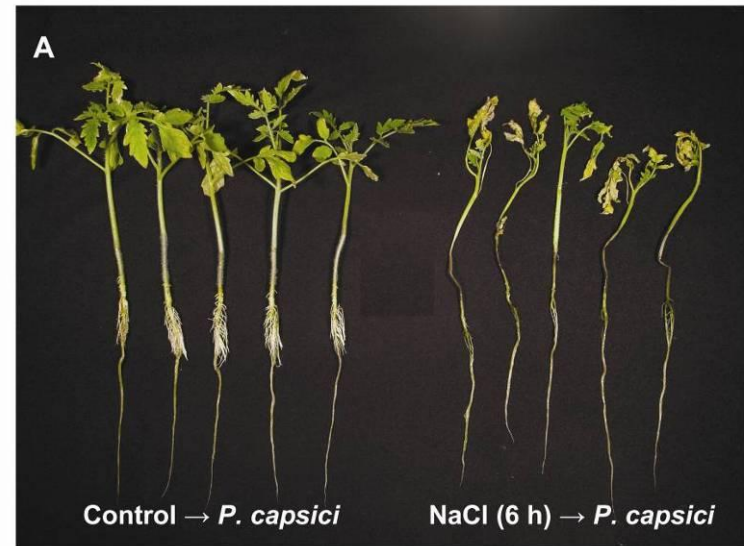
impacts on other hormone networks (JA, SA, CK, ET)

altered disease resistance

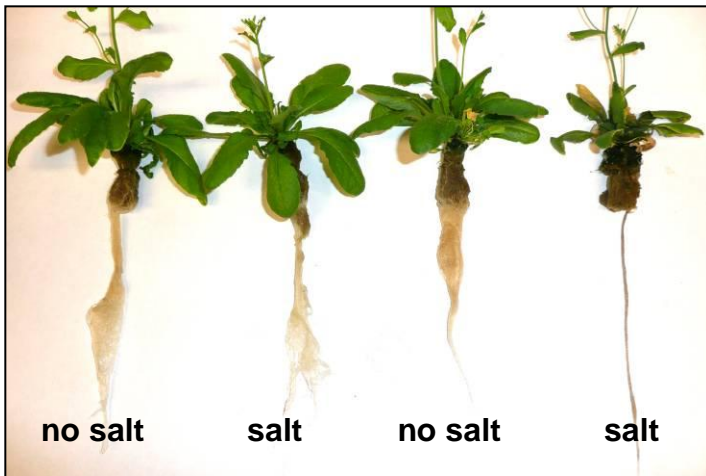
threshold for predisposition

**ABA's role in disease  
resistance and susceptibility  
of increasing interest**

# Other systems under study for predisposition research

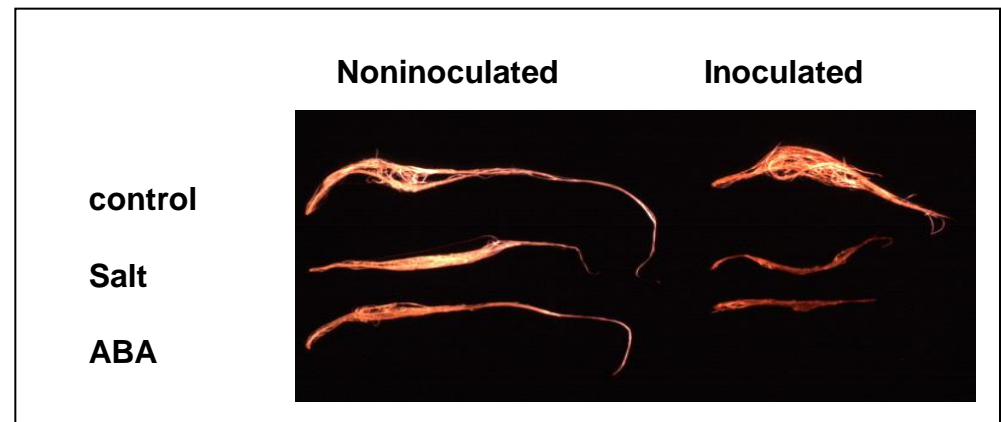


Salt predisposition in tomato – *Phytophthora capsici* interaction



noninoculated      inoculated w/ *P. capsici*

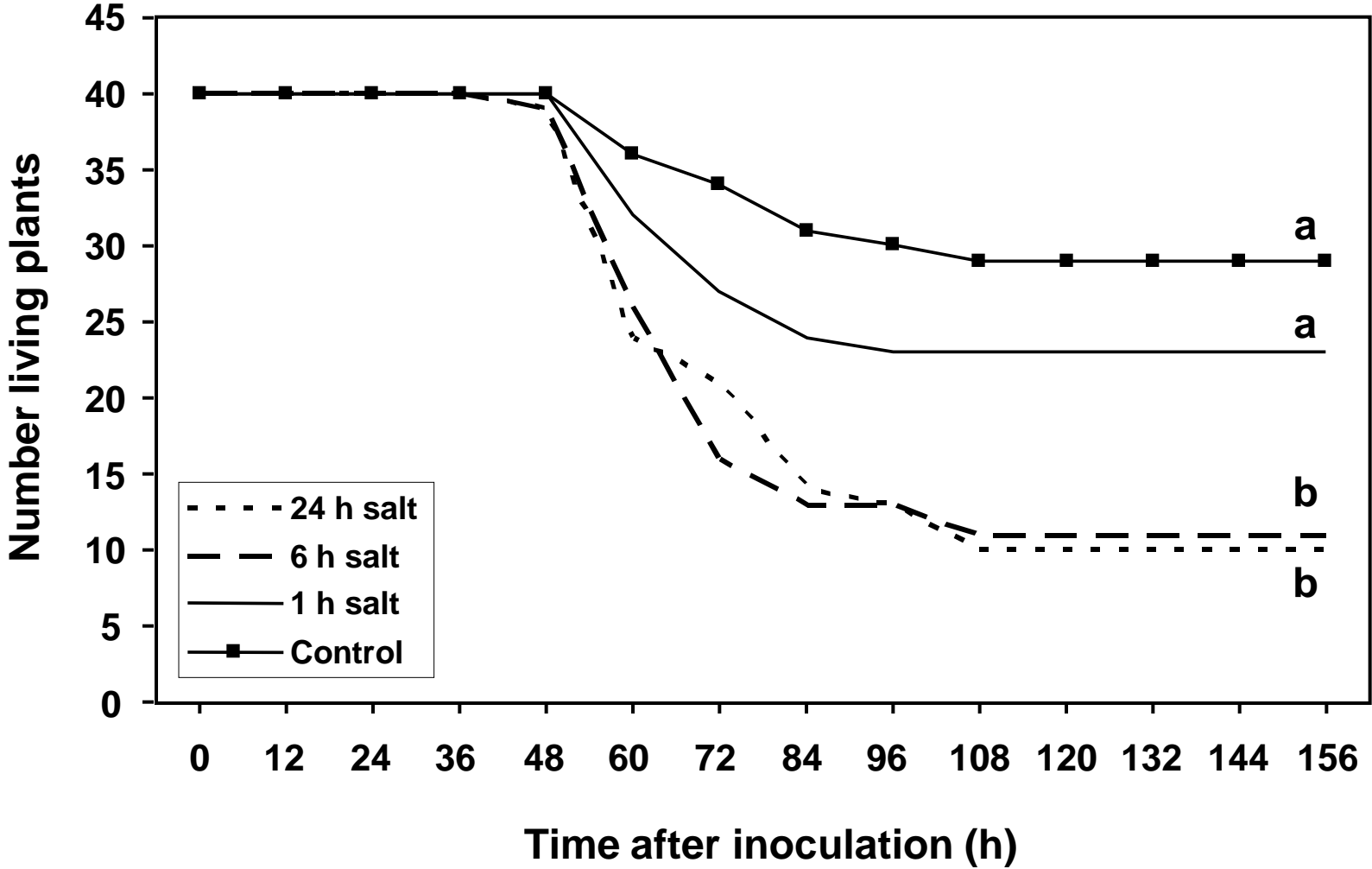
Arabidopsis and *Phytophthora capsici*.



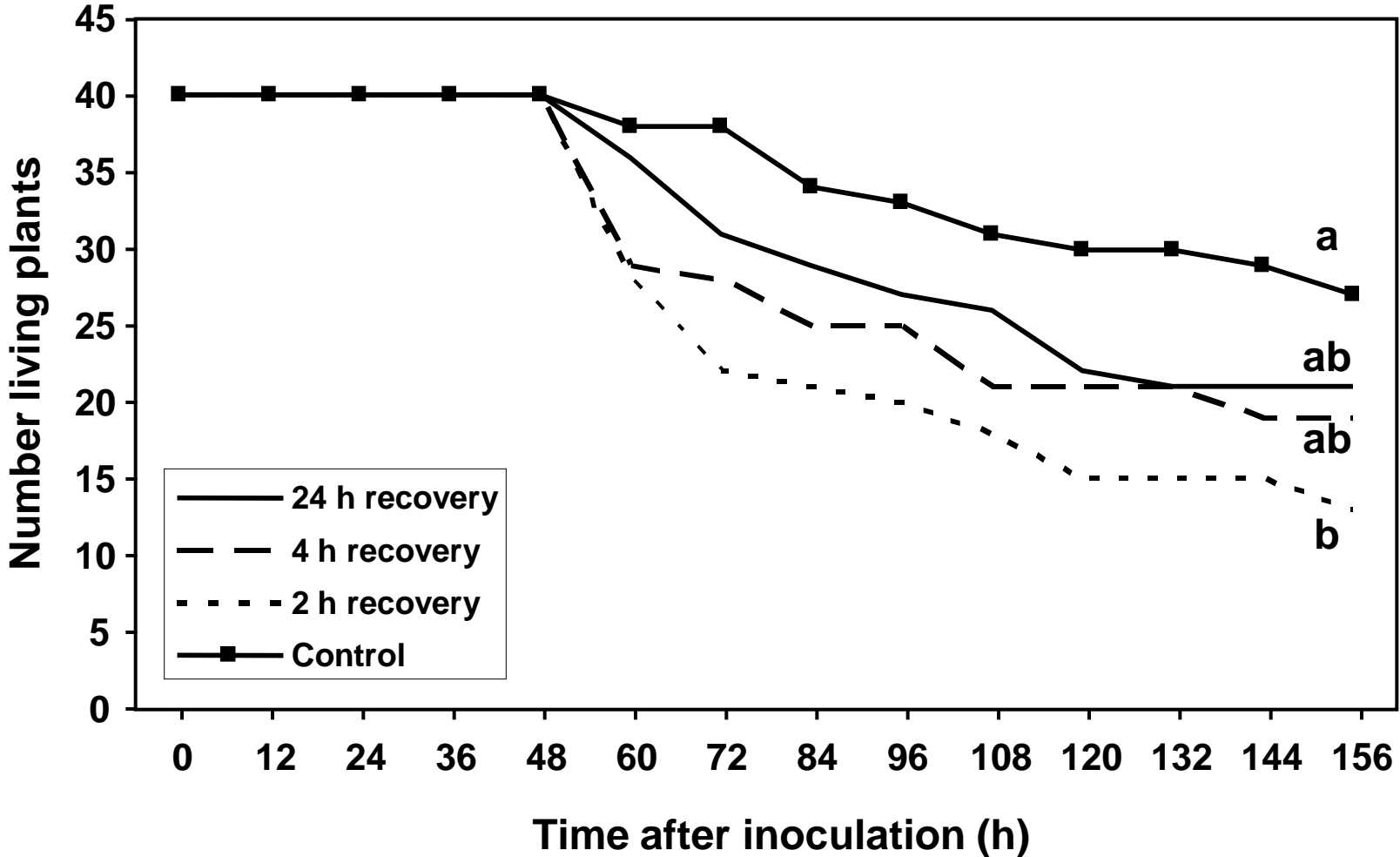
ABA can substitute for the root stress



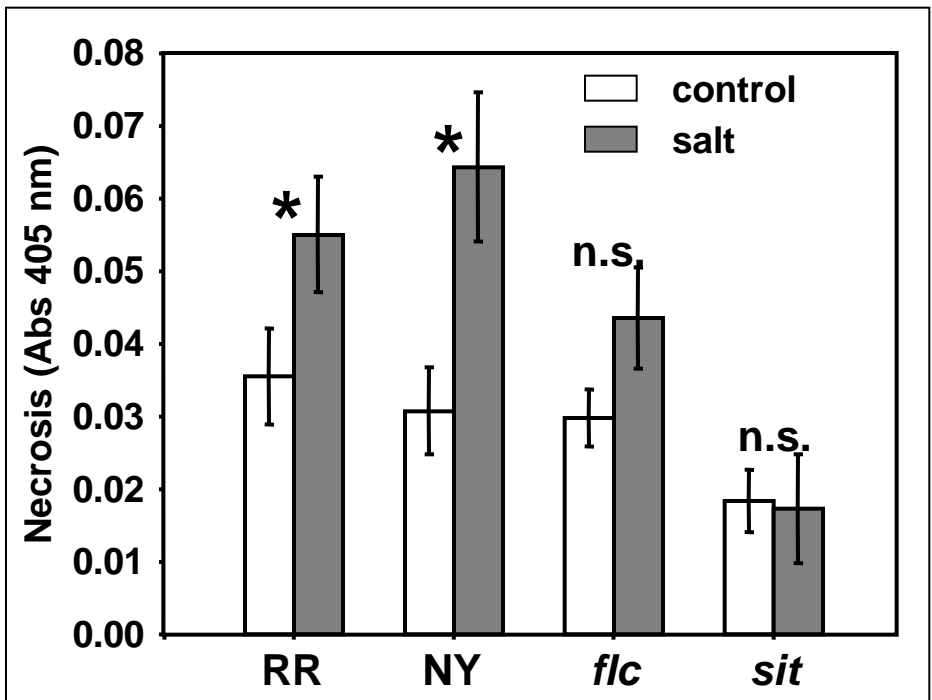
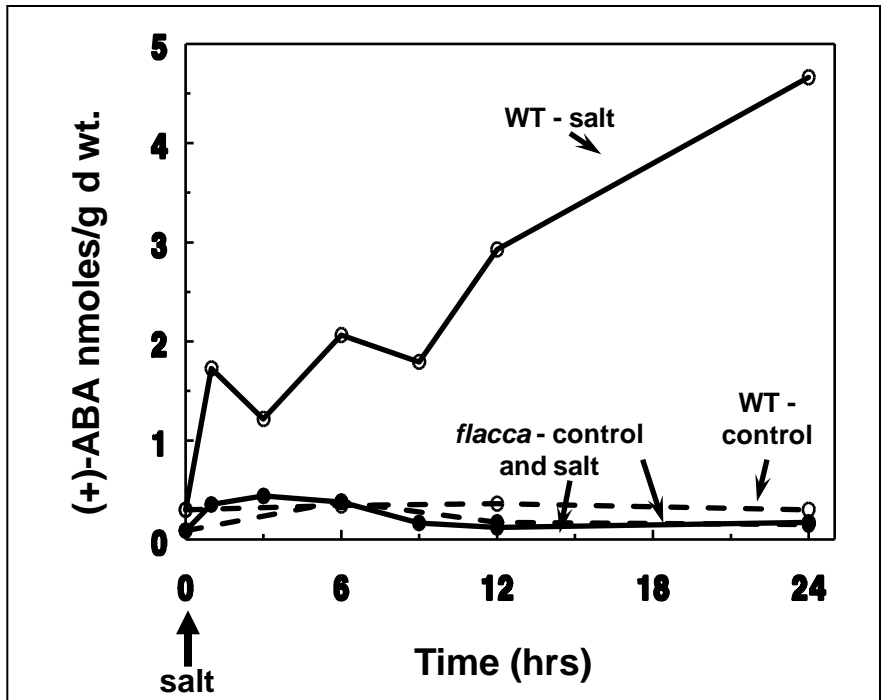
# Tomato seedling survival curves – 6 hour episode of salt stress sufficient to predispose



# Tomato seedling survival curves – stress effect on resistance can persist for up to 24 hr



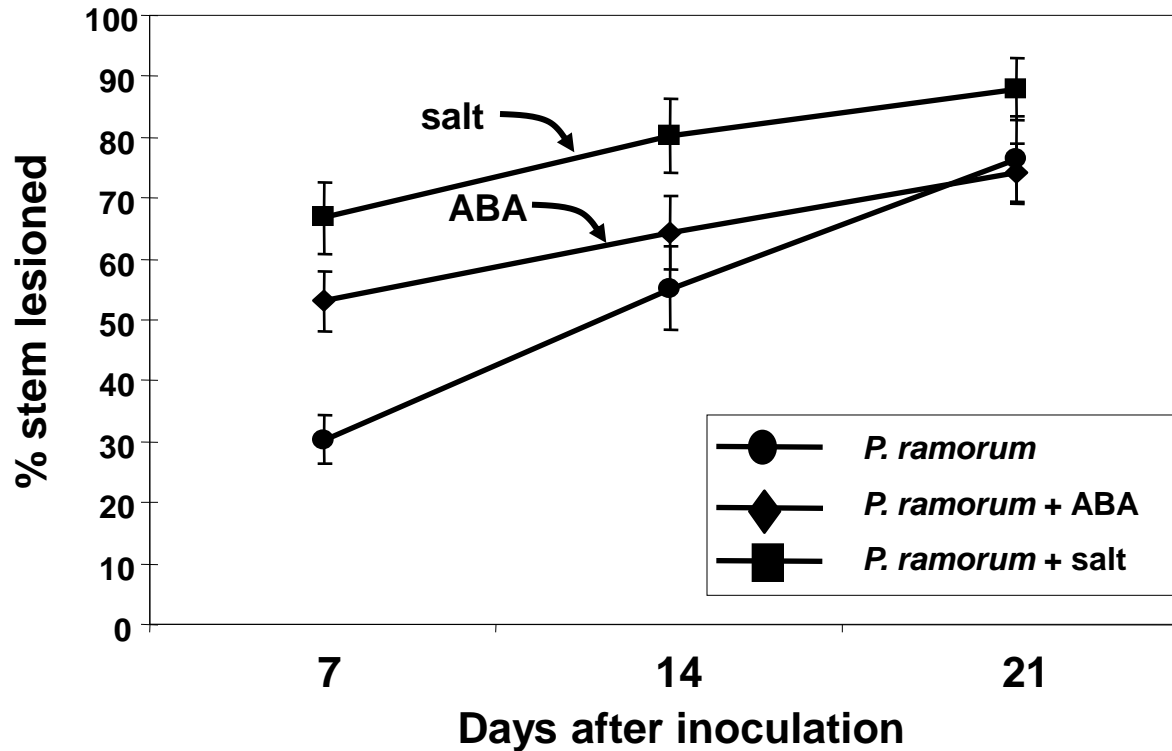
# Tomato ABA mutants (*flacca*, *sitiens*) response to salt and *P. capsici*



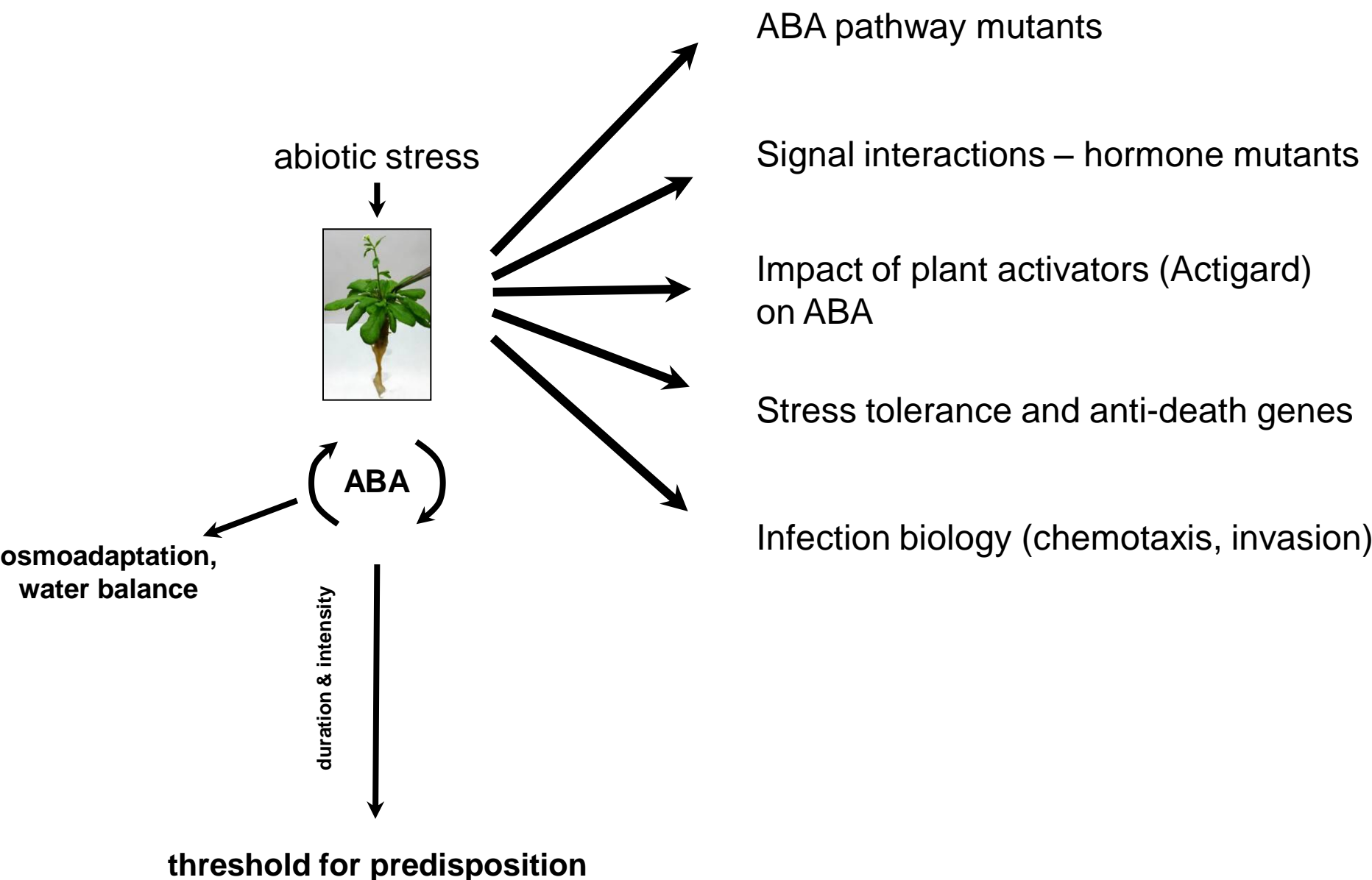
**ABA increases rapidly in wild type roots during salt stress but not in ABA mutants**

**ABA mutants (*flc*, *sit*) are not as “predisposable” as wild type (RR, NY)**

# ABA stimulates ramorum blight development in *Rhododendron*



**ABA treatment partially mimics the effect of salt of disease development**



abiotic stress



ABA

osmoadaptation,  
water balance

duration & intensity

threshold for predisposition

ABA pathway mutants

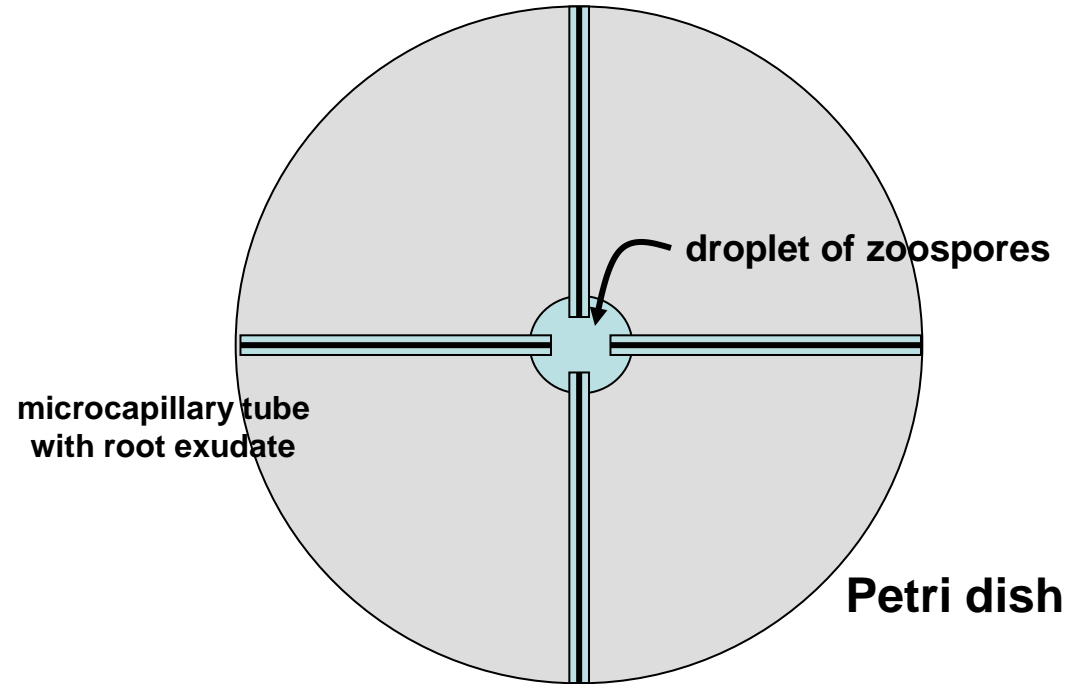
Signal interactions – hormone mutants

Impact of plant activators (Actigard)  
on ABA

Stress tolerance and anti-death genes

Infection biology (chemotaxis, invasion)

# Zoospore motility choice assay – chemoattraction of root exudates



**exudate from:**

**salted roots**

**control roots**



# Implications

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**Brief episodes of abiotic stress impair basic disease resistance mechanisms in roots and shoots**

**Root stress impact is on host physiology and pathogen behavior**

**Mild episodic stress can affect –**

- **inoculum thresholds necessary for disease**
- **extent and significance of root infections in various hosts**
- **consistency and reliability of pathogenicity tests for host resistance**
- **efficacy of chemical treatments to manage disease**

# **Current research – *Rhododendron* and *P. ramorum***

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**Assess other abiotic factors – N rates, chilling, waterlogging, water deficit – for capacity to stimulate soilborne and cryptic infections.**

**Does root stress reduce fungicide efficacy?**

**Can plant activators mitigate abiotic stress effects on ramorum blight development?**

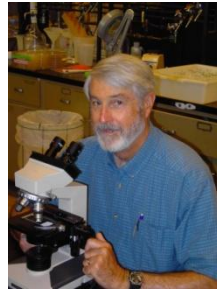


# Acknowledgements

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**Jim MacDonald**  
**Dave Rizzo**



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