How do *Oncosiphon piluliferum* soil legacies affect native forbs?

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Oncosiphon piluliferum

Stinknet or globe chamomile, in *Asteraceae*

Present in Riverside County at low densities since the 80's but has rapidly increased in cover in the last several years

Cal-IPC Rating: Watch

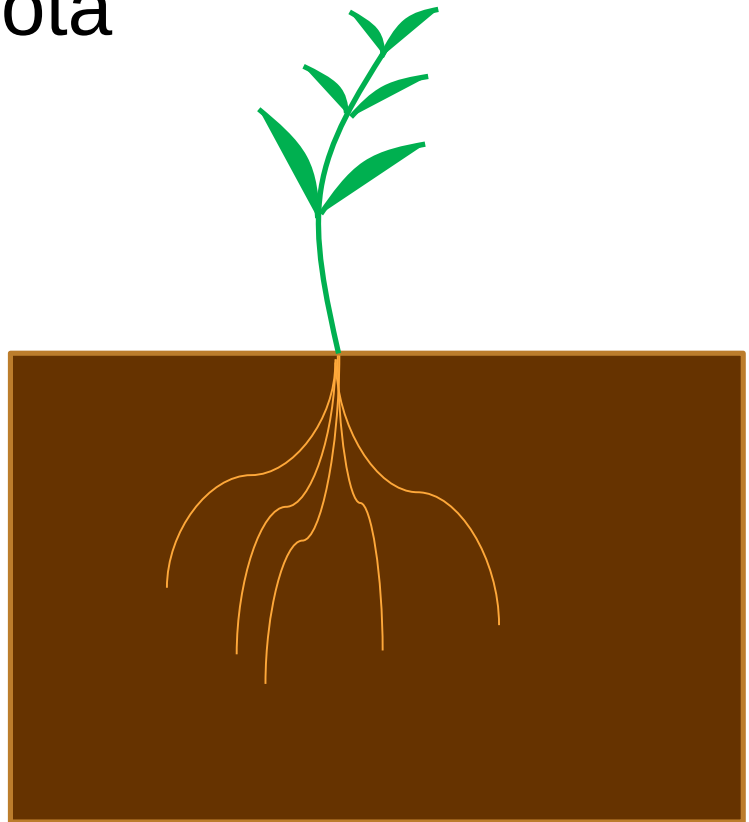

Melanie Burlaza

How do *Oncosiphon* soil legacies inhibit native forb establishment?

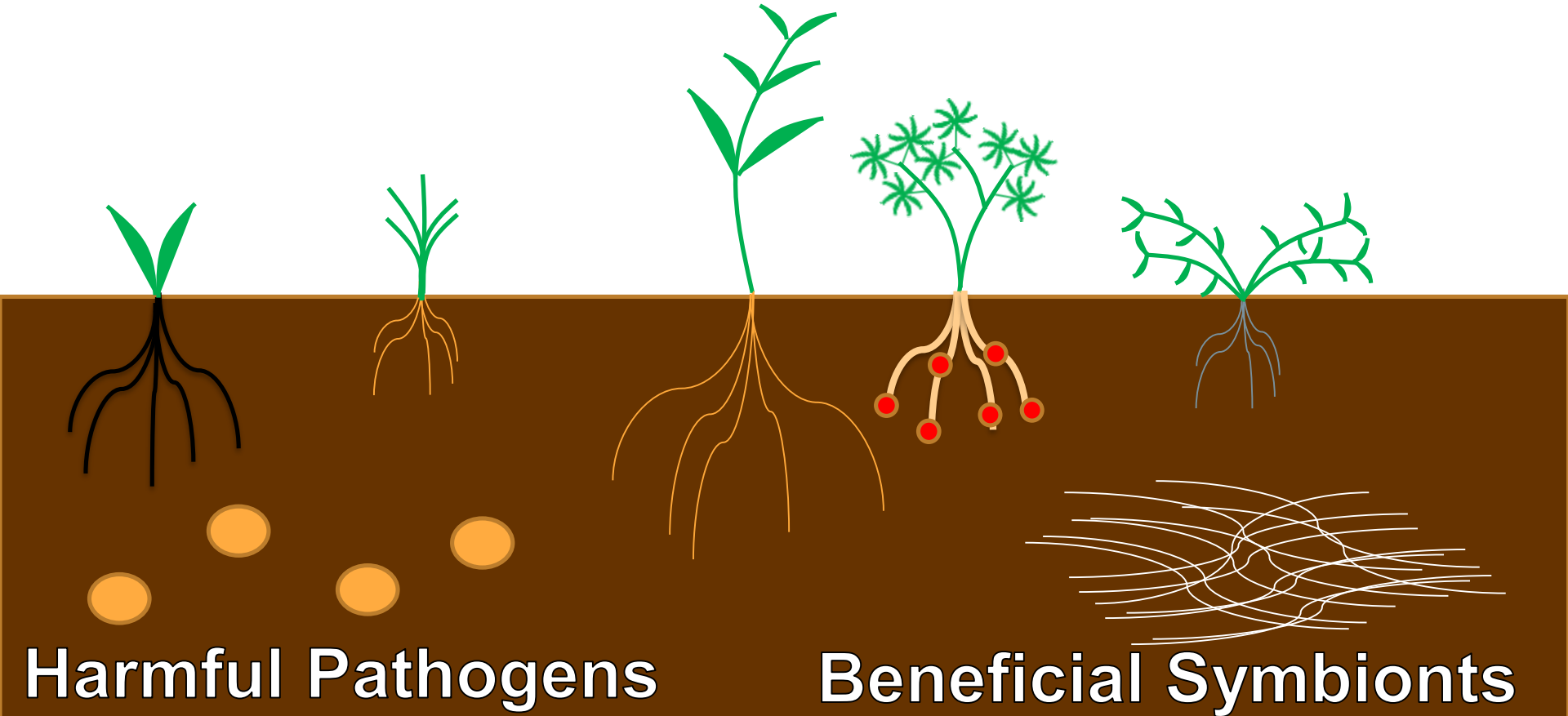
How does time since invasion affect the strength of any legacy present?

Plant Soil Feedbacks

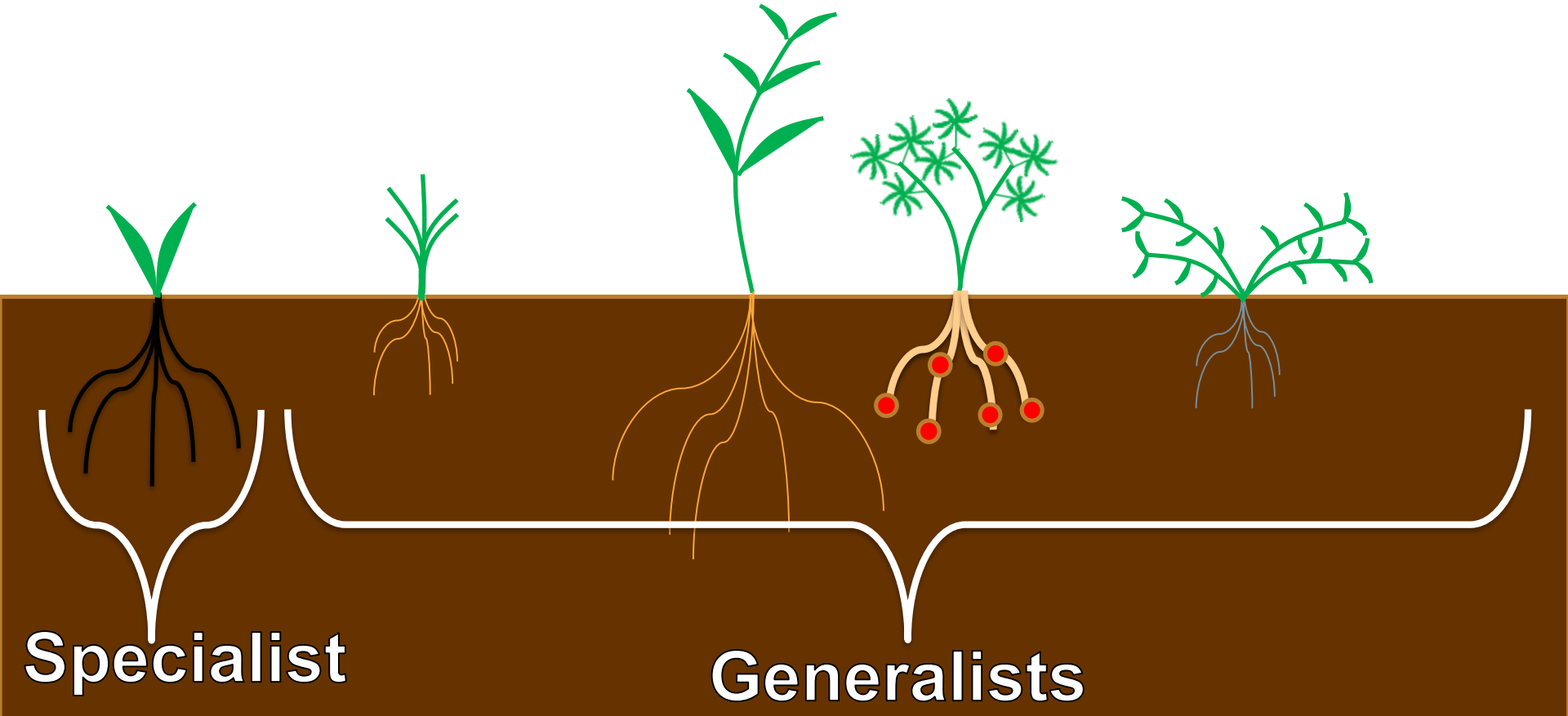
- Plants interact with soil microbiota
- Effects their own performance
- Effects performance of other plants



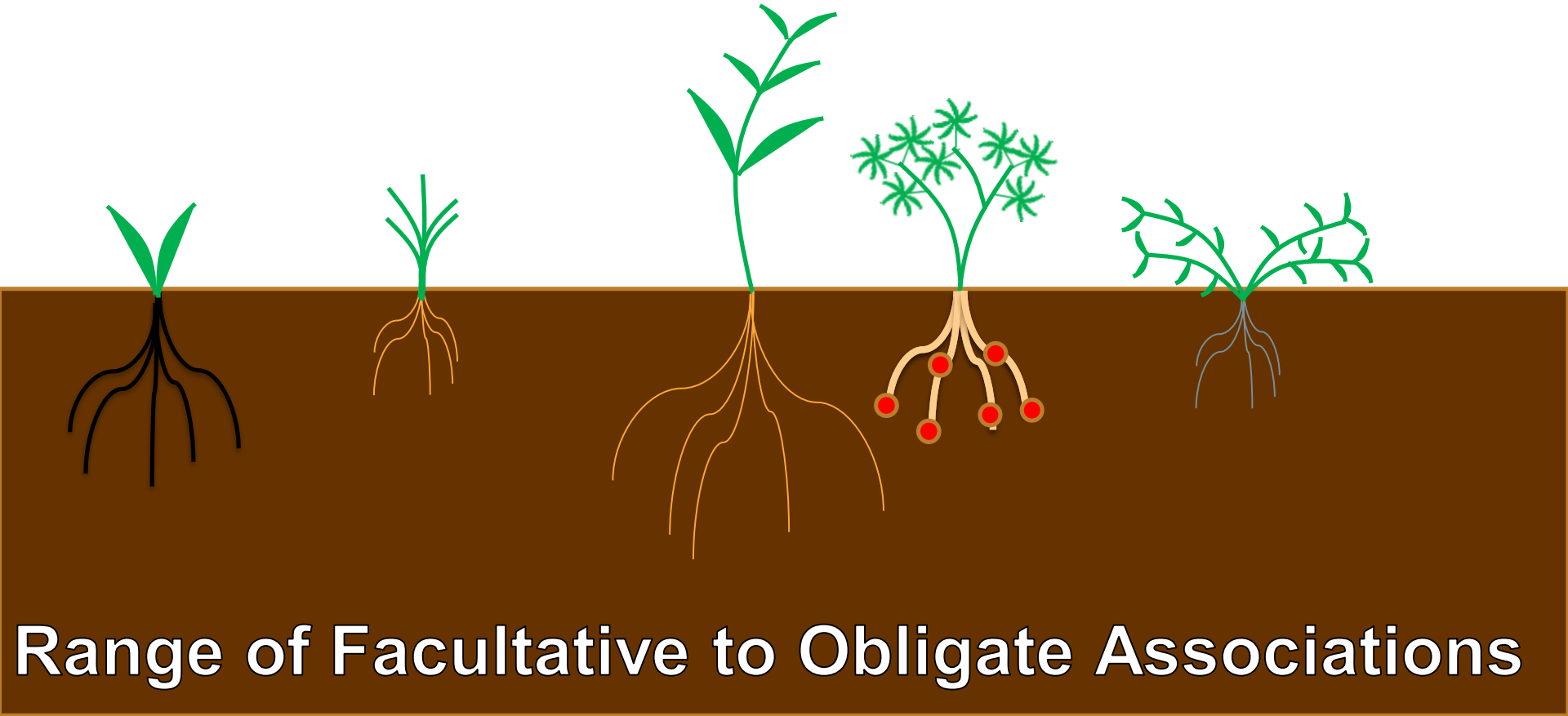
Plant Soil Feedbacks



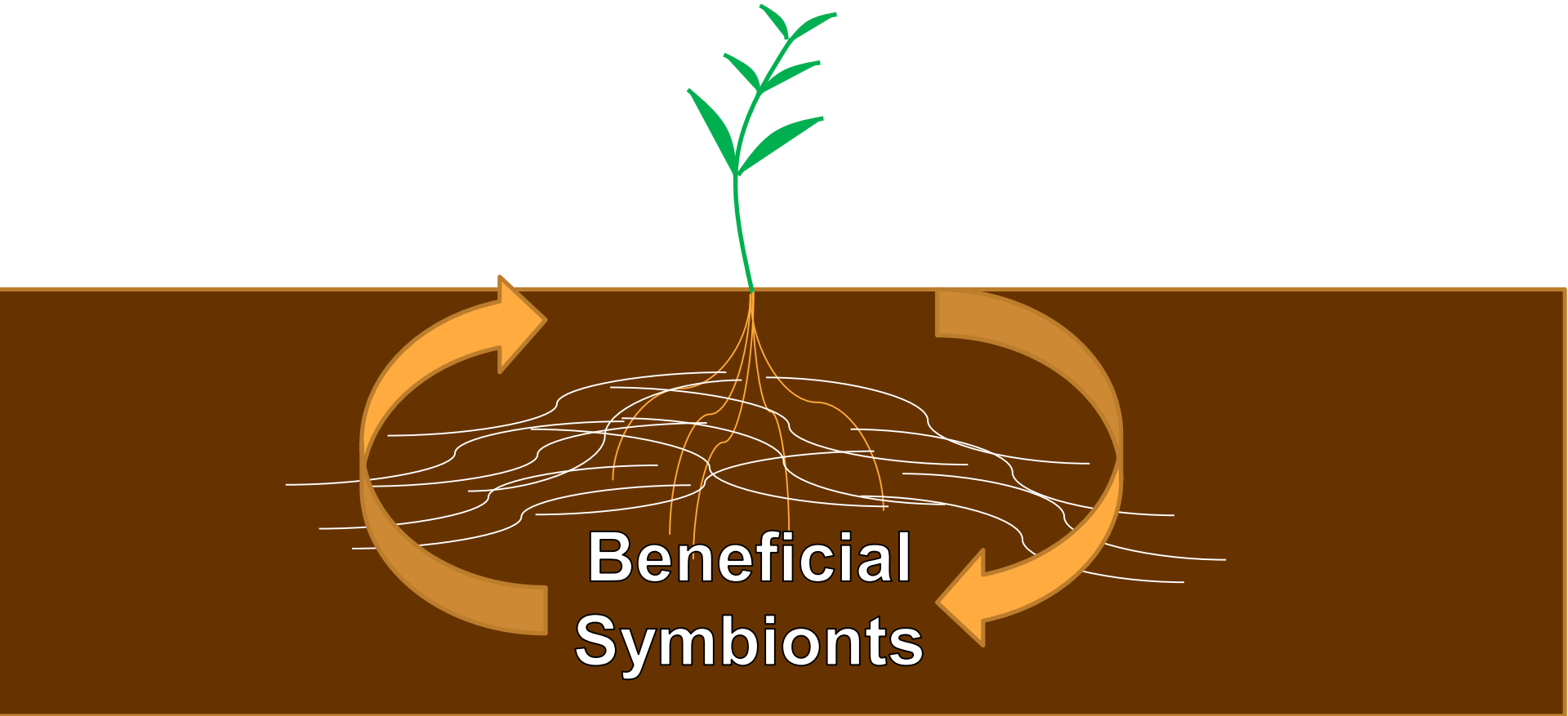
Plant Soil Feedbacks



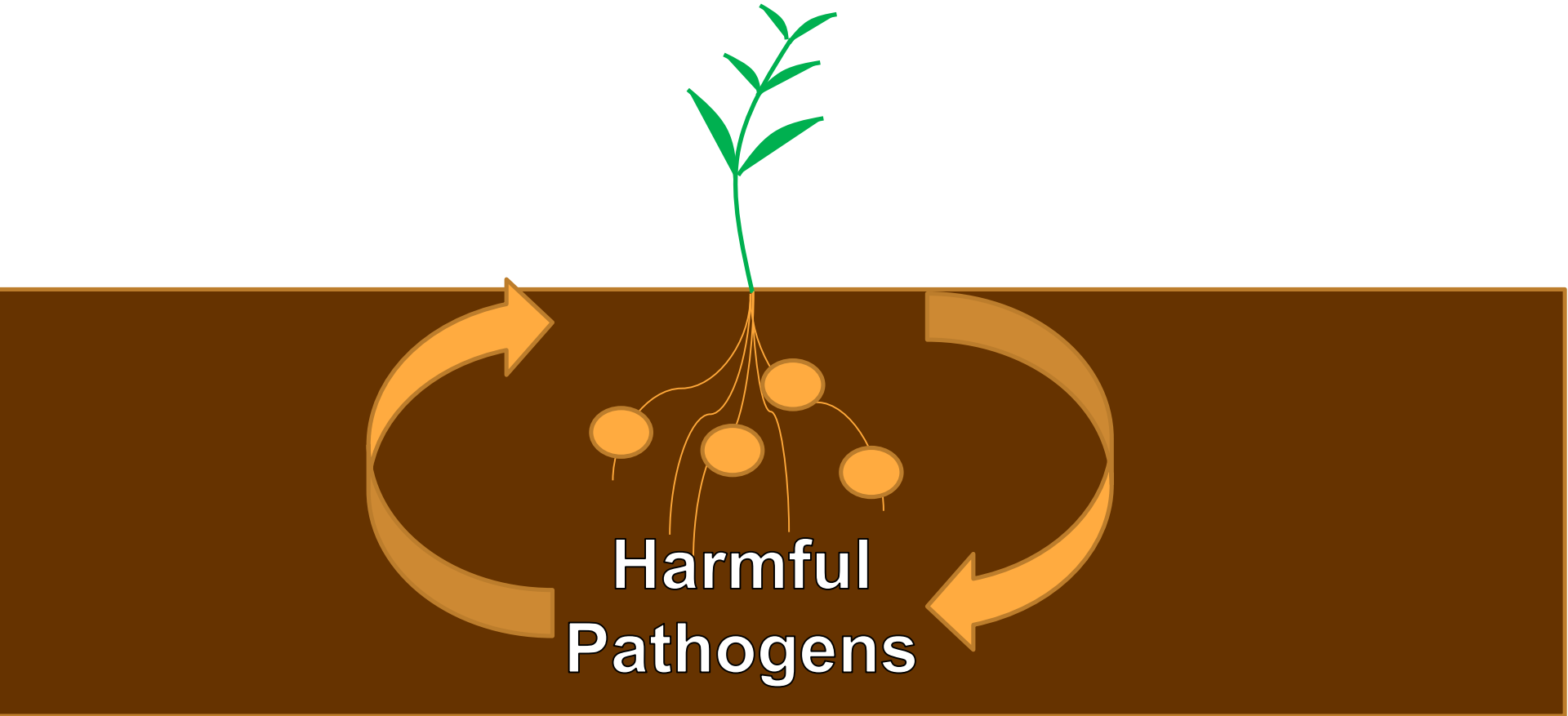
Plant Soil Feedbacks



Positive feedback



Negative feedback



Plant and Soil Communities

- Shared evolutionary history
- Mix of obligate/facultative, specialist/generalist:
  - Certain native plants really need a very specific microbial partner
    - (Obligate specialist)
  - Some native plants really need *a* microbial partner
    - (Obligate generalist)
  - Some native plants do not need a microbial partner
    - (Facultative)

Invasion & Plant Soil Conditioning Hypotheses

- Enhanced Mutualisms

Funk & Vitousek 2007

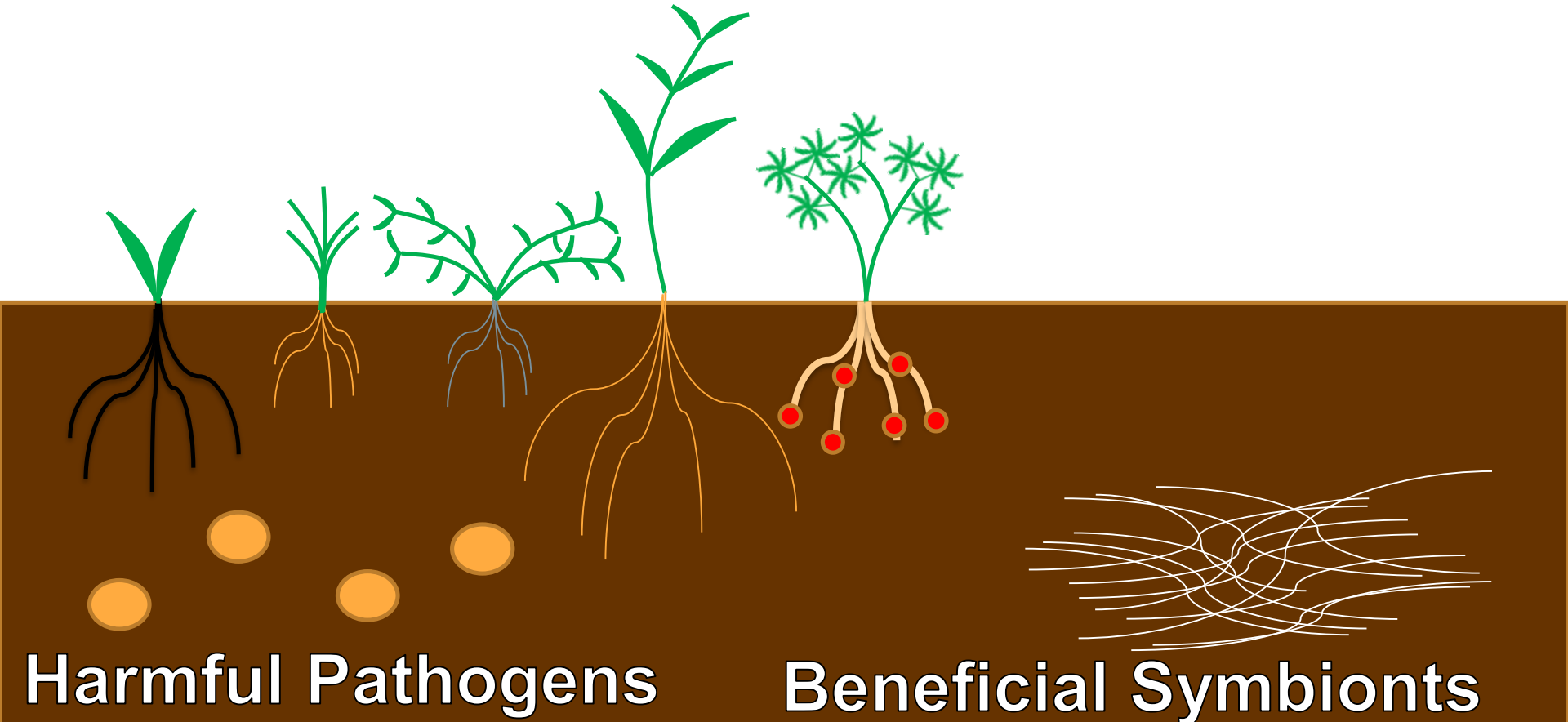
- Degraded Mutualisms

Vogelsang & Bever 2009

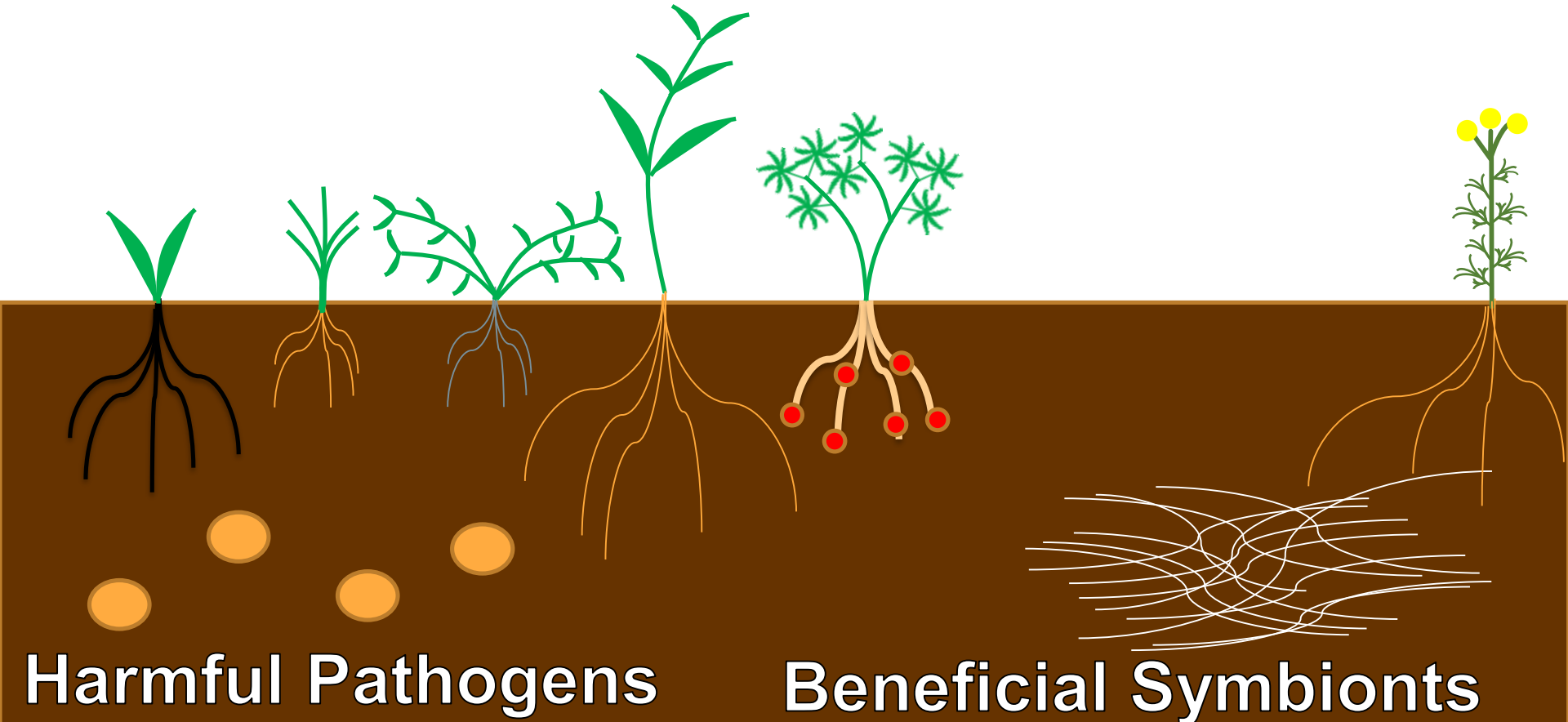
- Pathogen loading

Reinhart & Callaway 2006

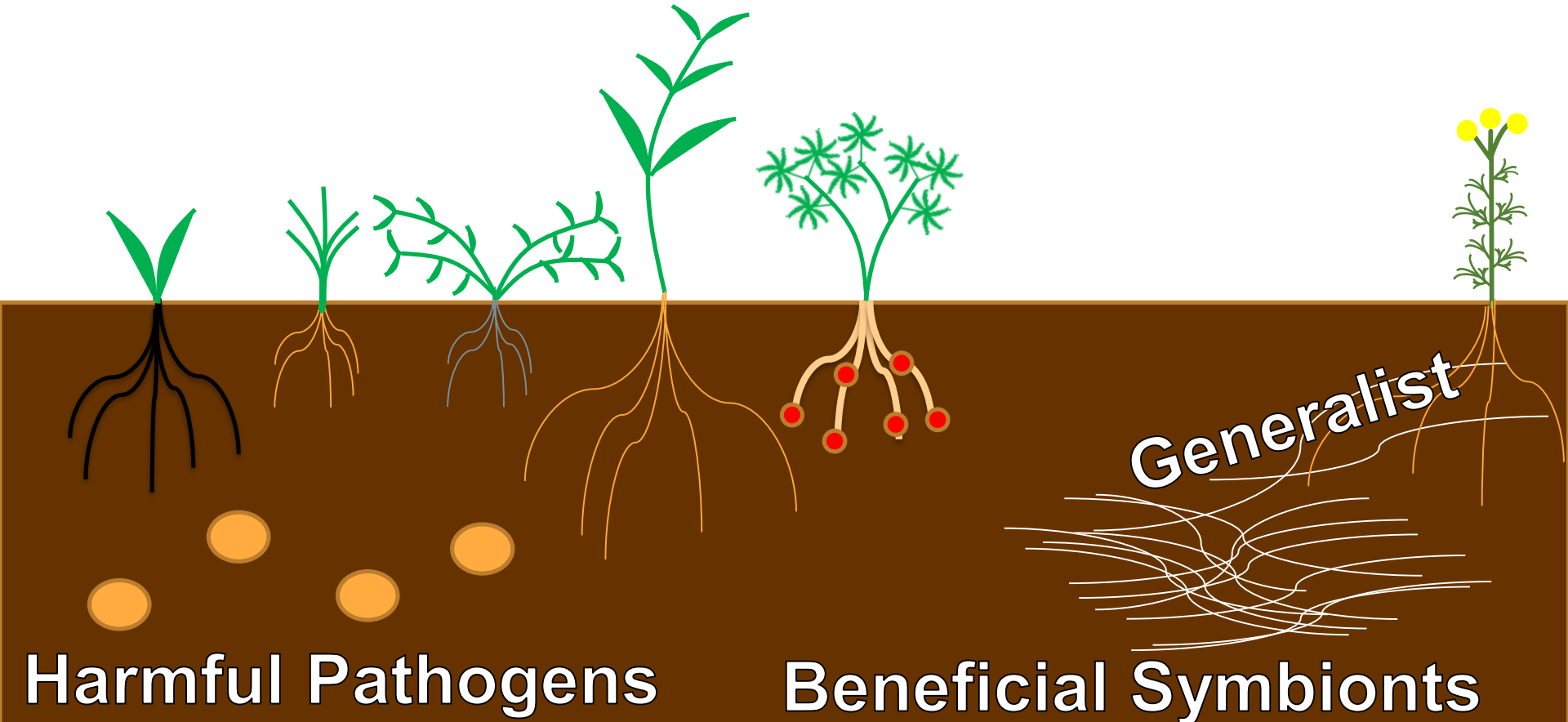
Enhanced Mutualisms



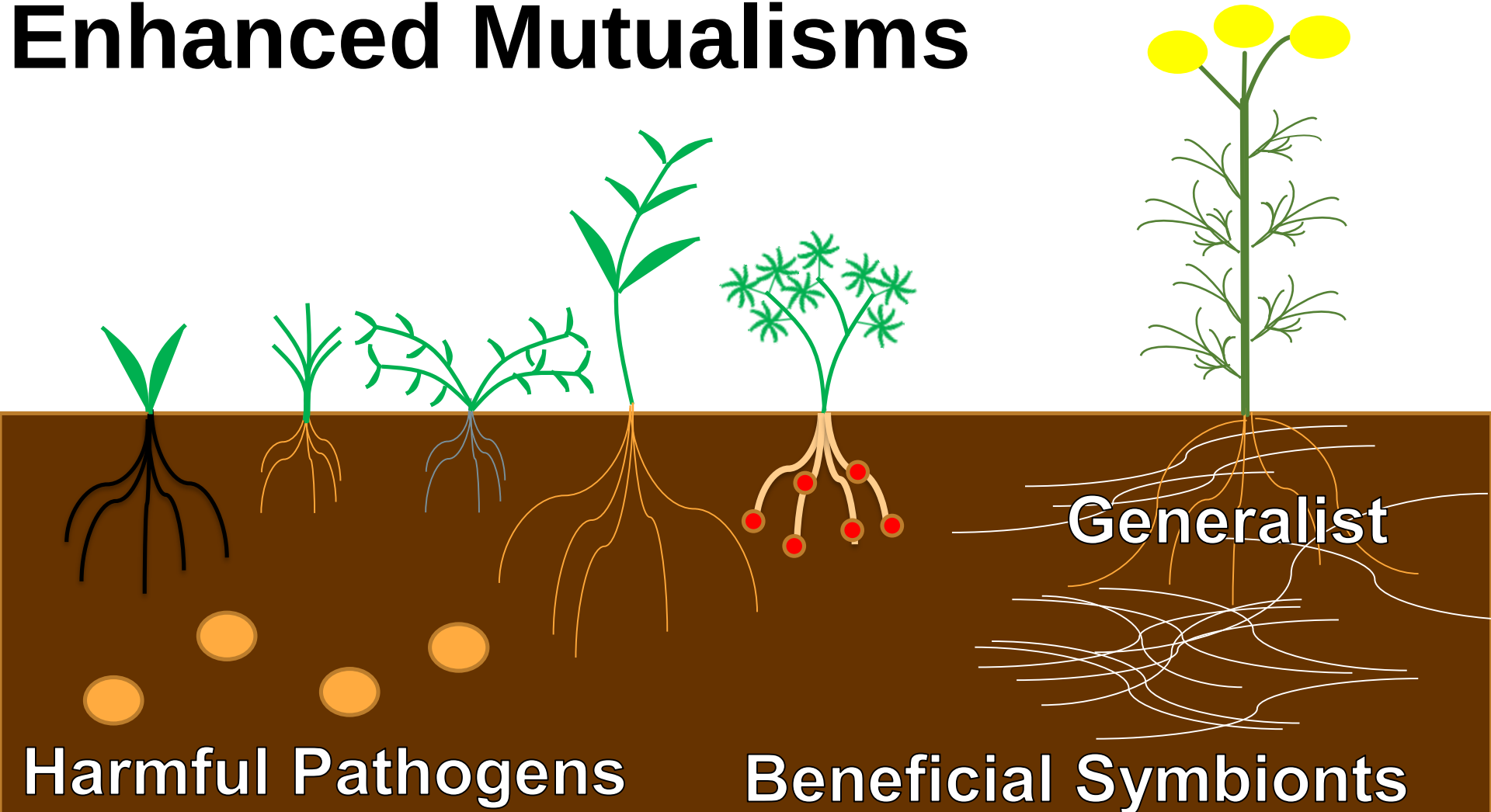
Enhanced Mutualisms



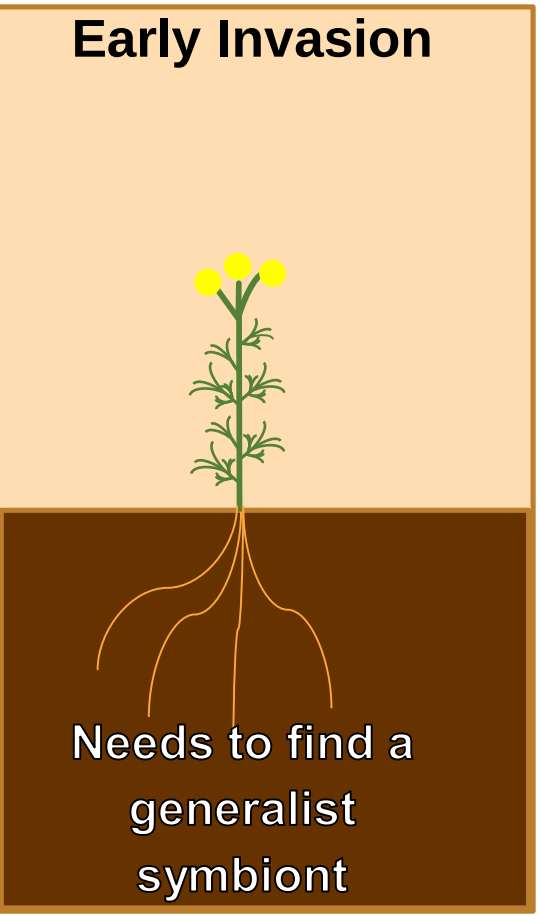
Enhanced Mutualisms



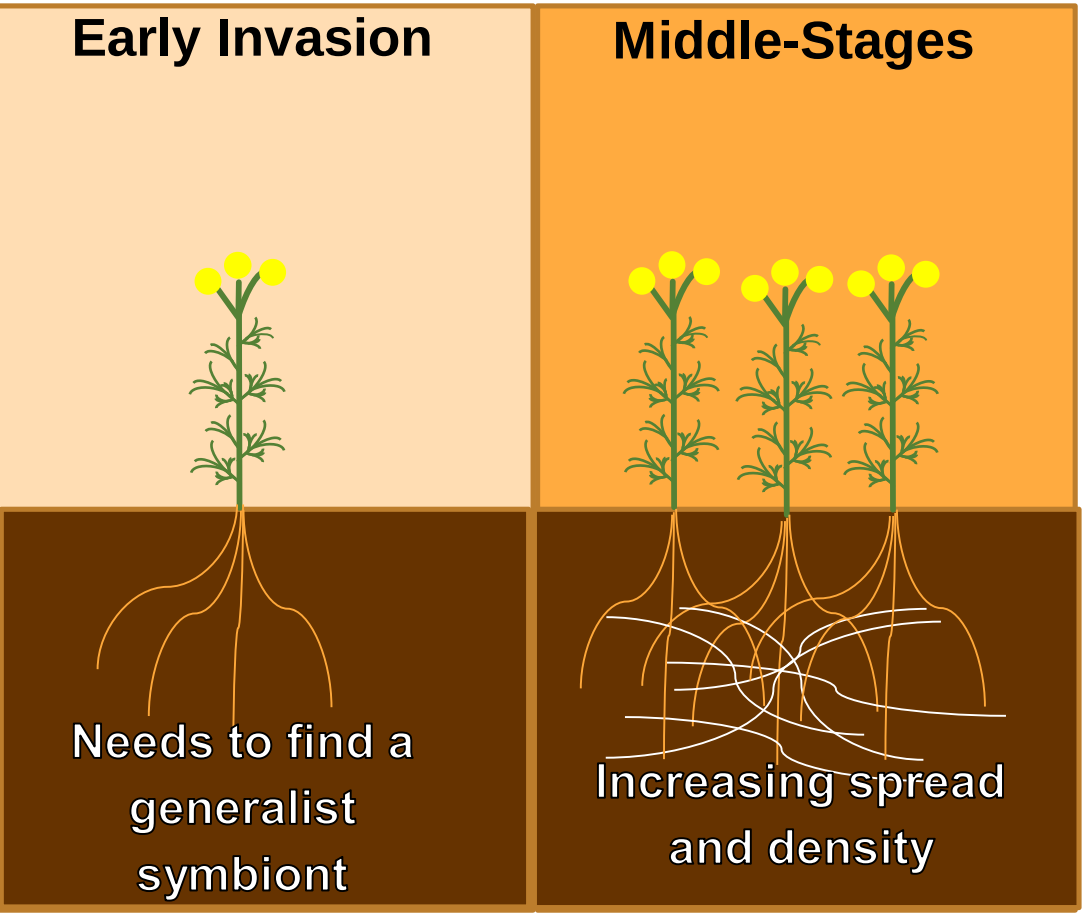
Enhanced Mutualisms



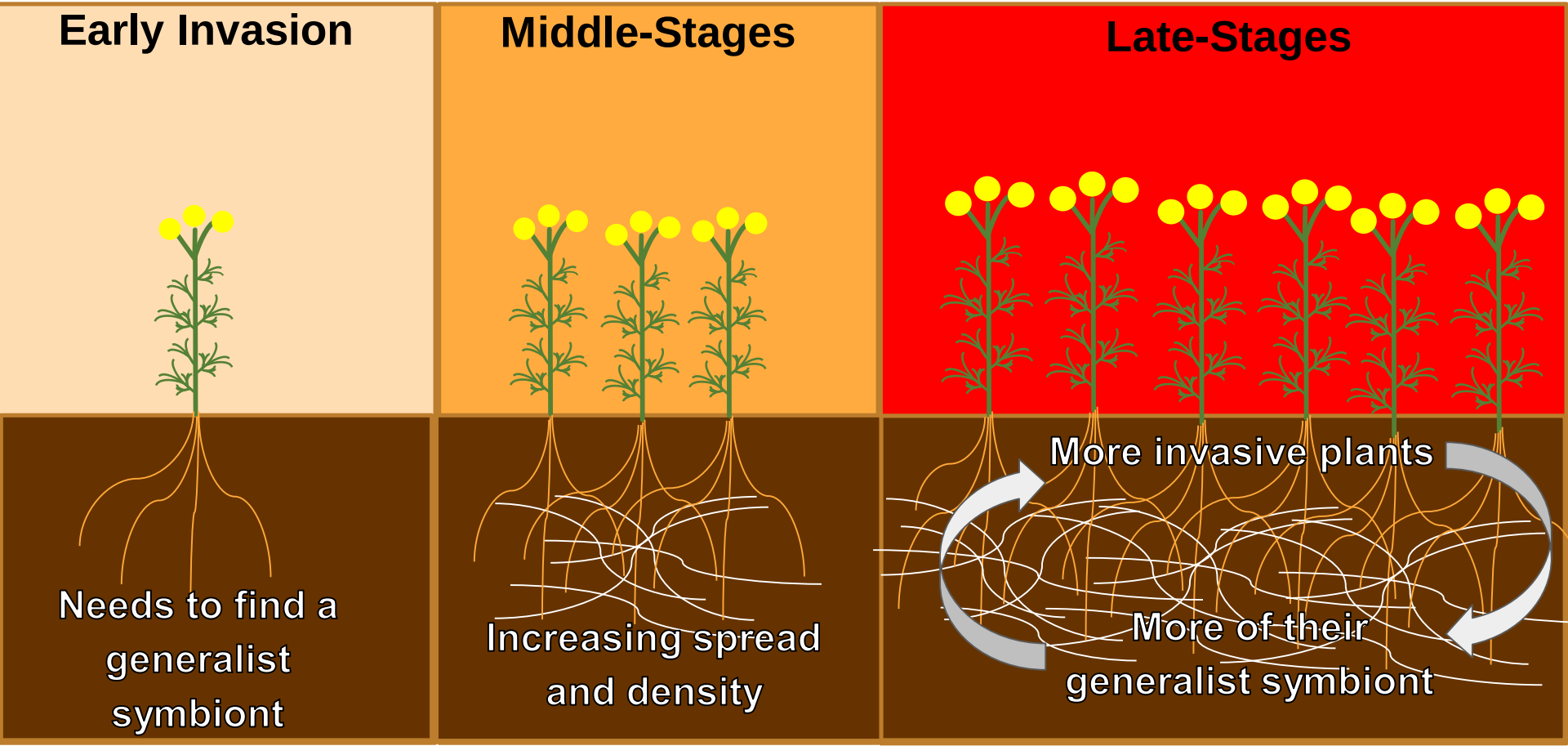
How enhanced mutualisms may change



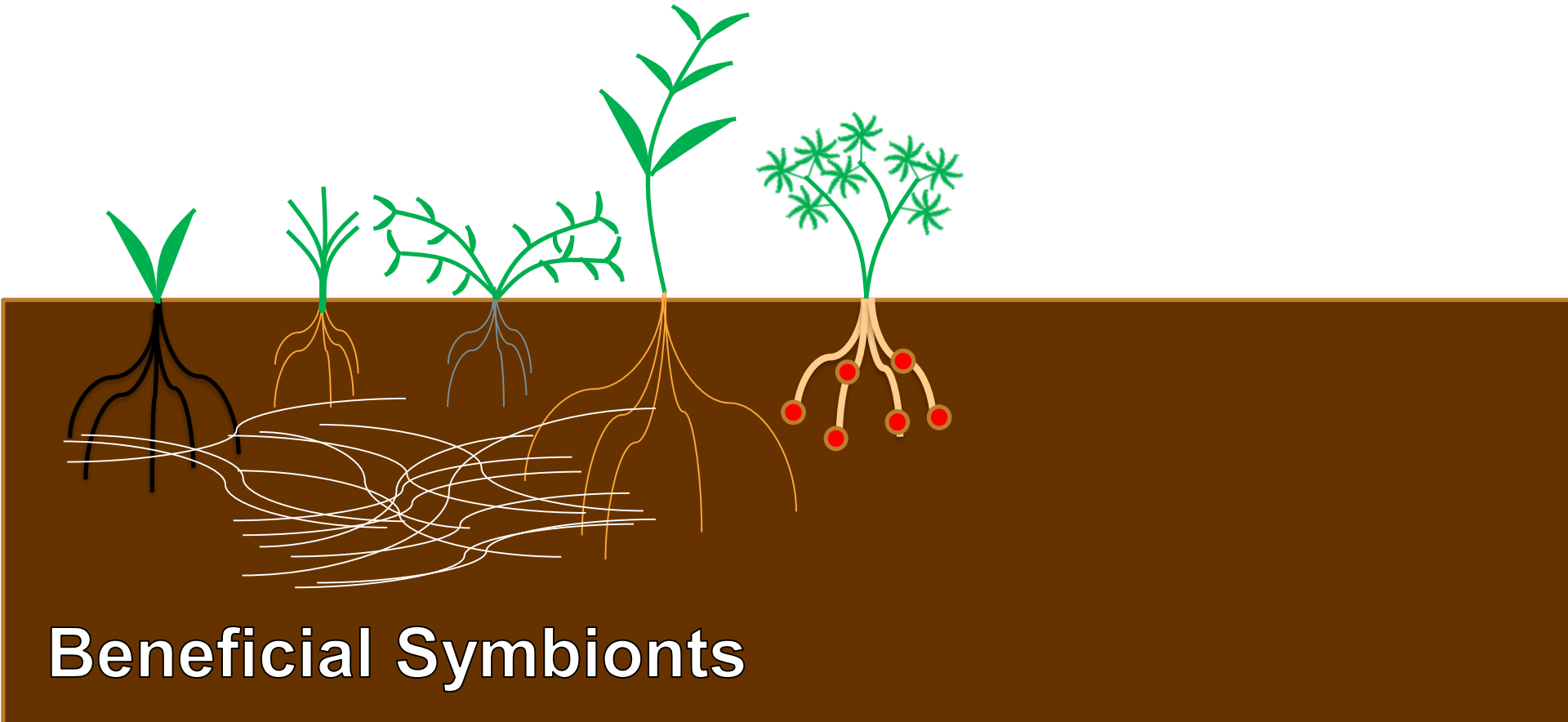
How enhanced mutualisms may change



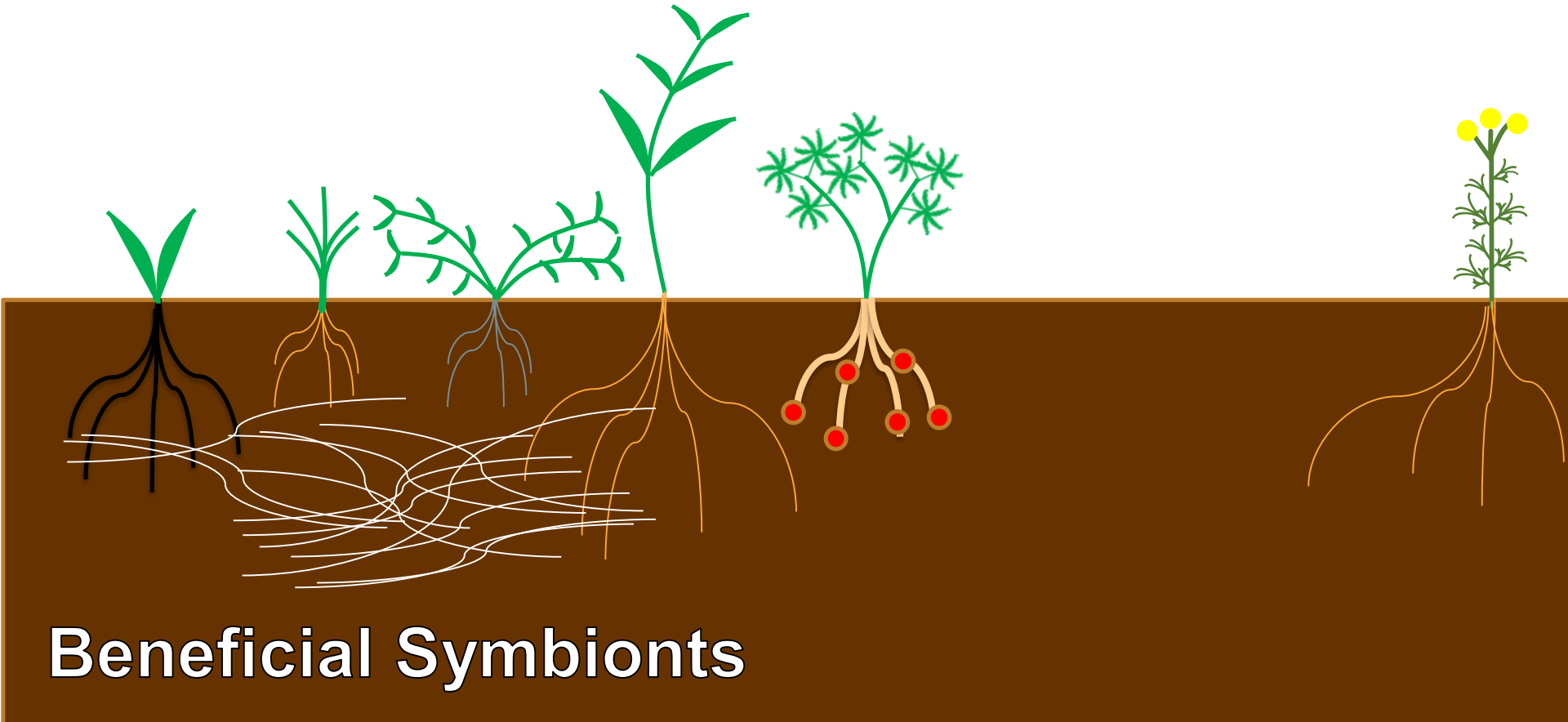
How enhanced mutualisms may change



Degraded Mutualisms



Degraded Mutualisms



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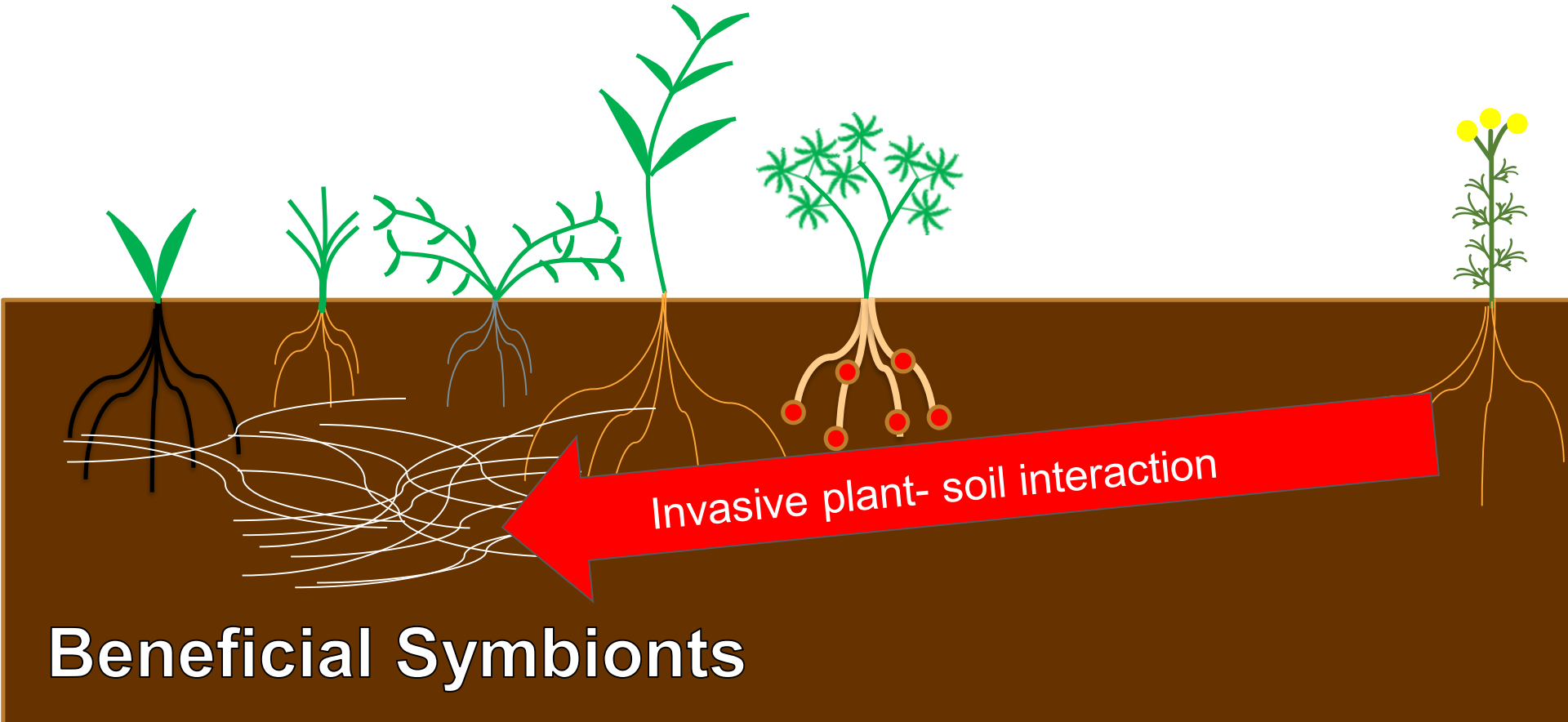
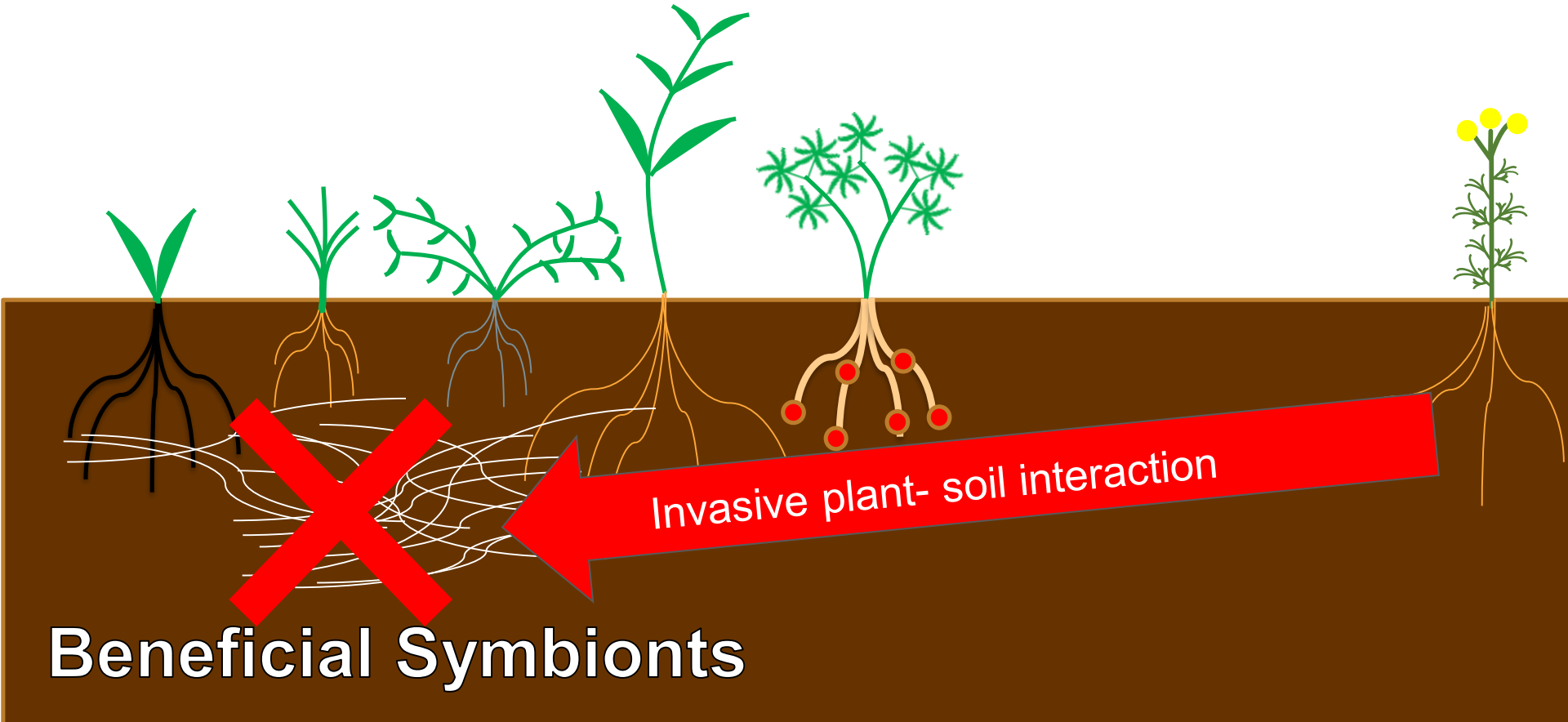
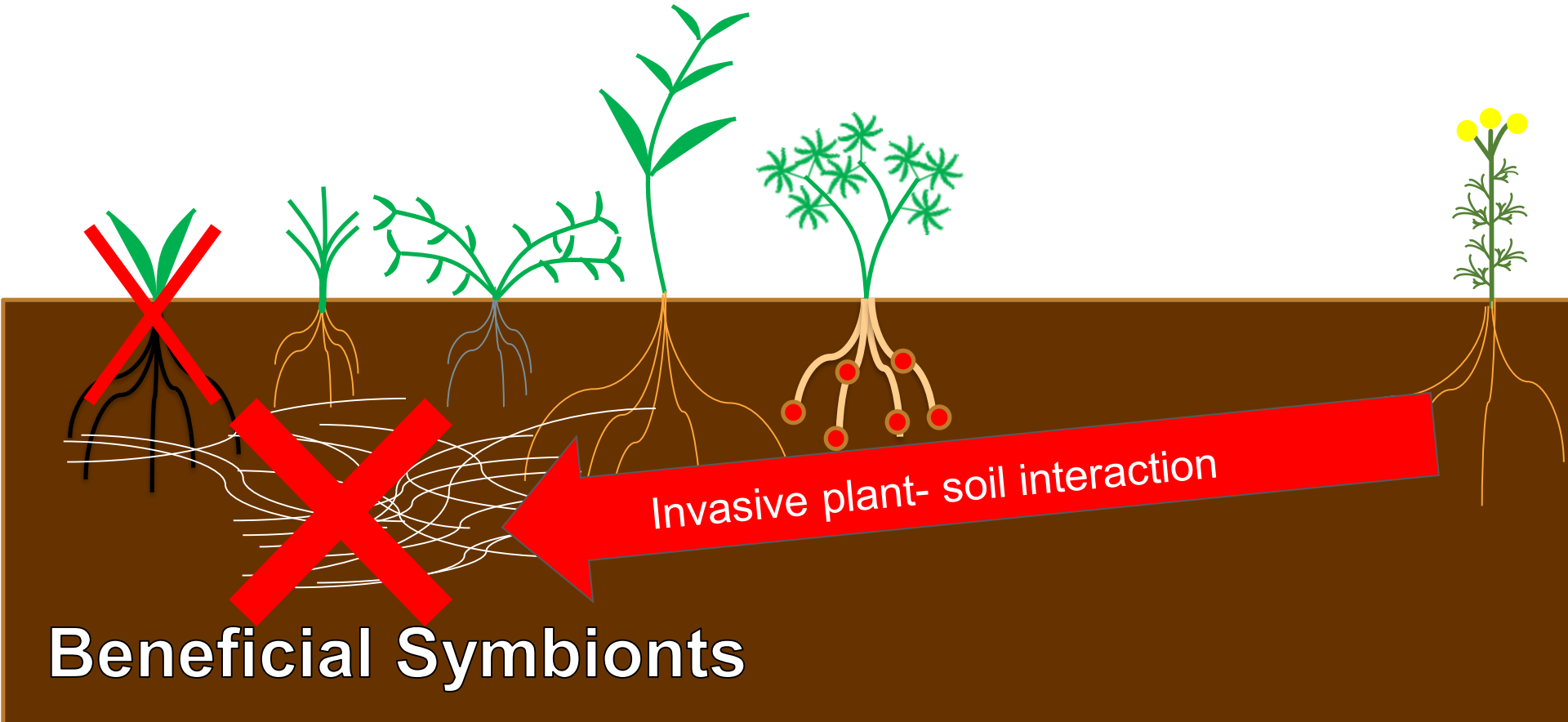


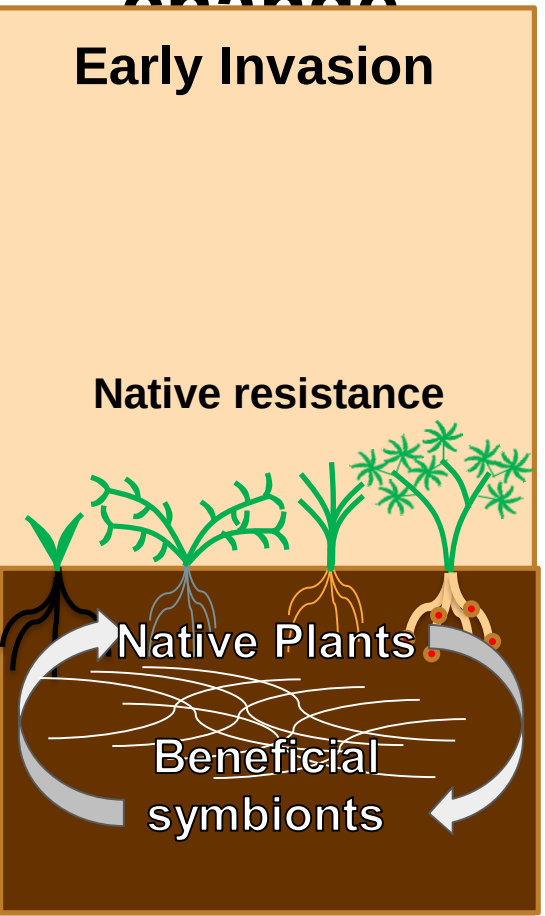
Degraded Mutualisms



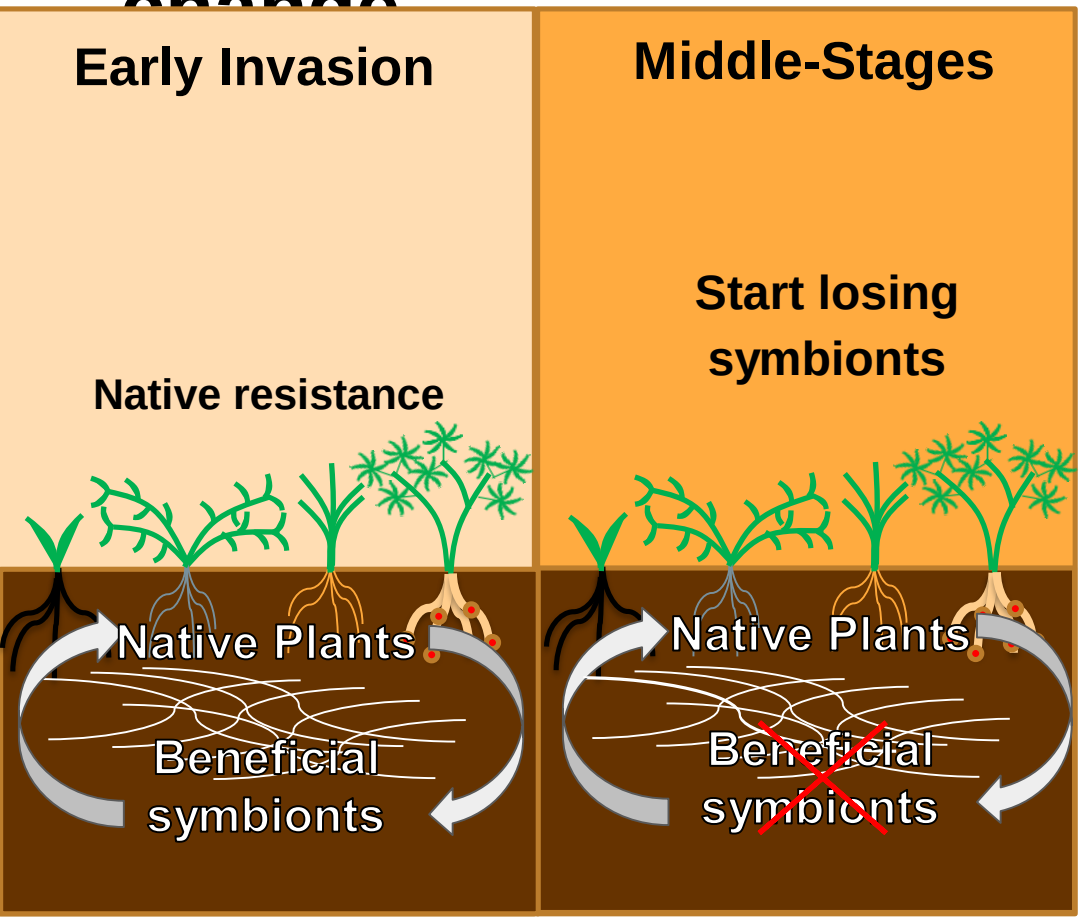
Degraded Mutualisms



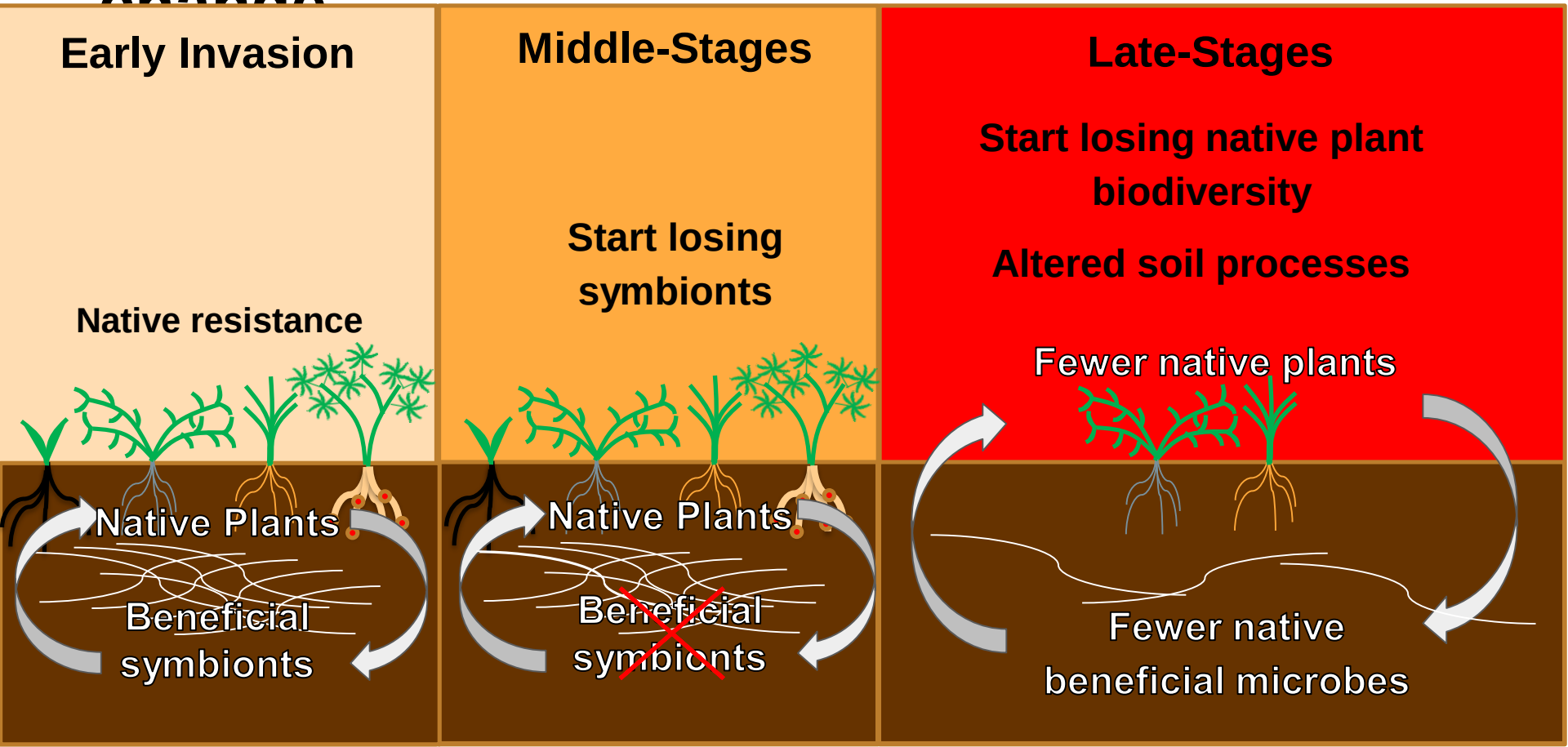
How degraded mutualisms may change



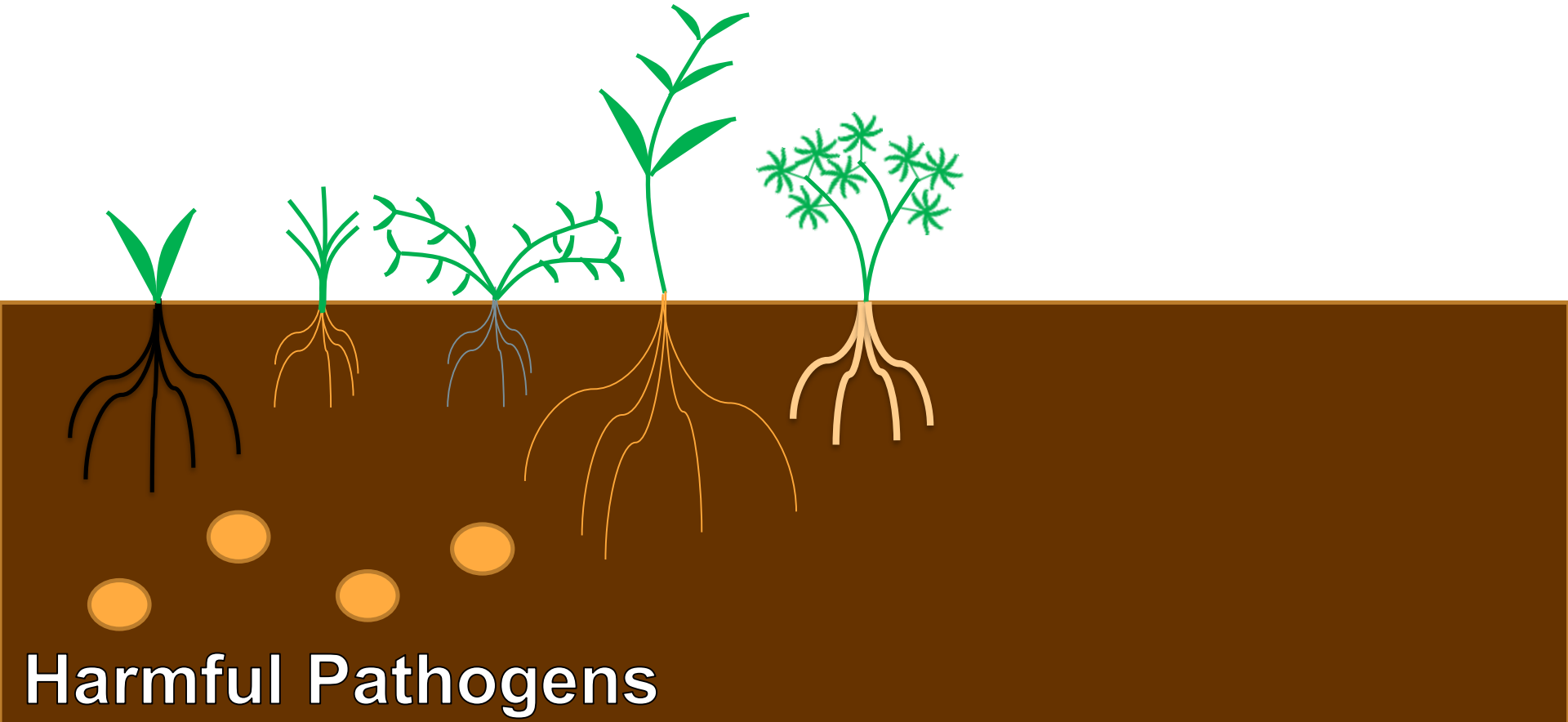
How degraded mutualisms may change



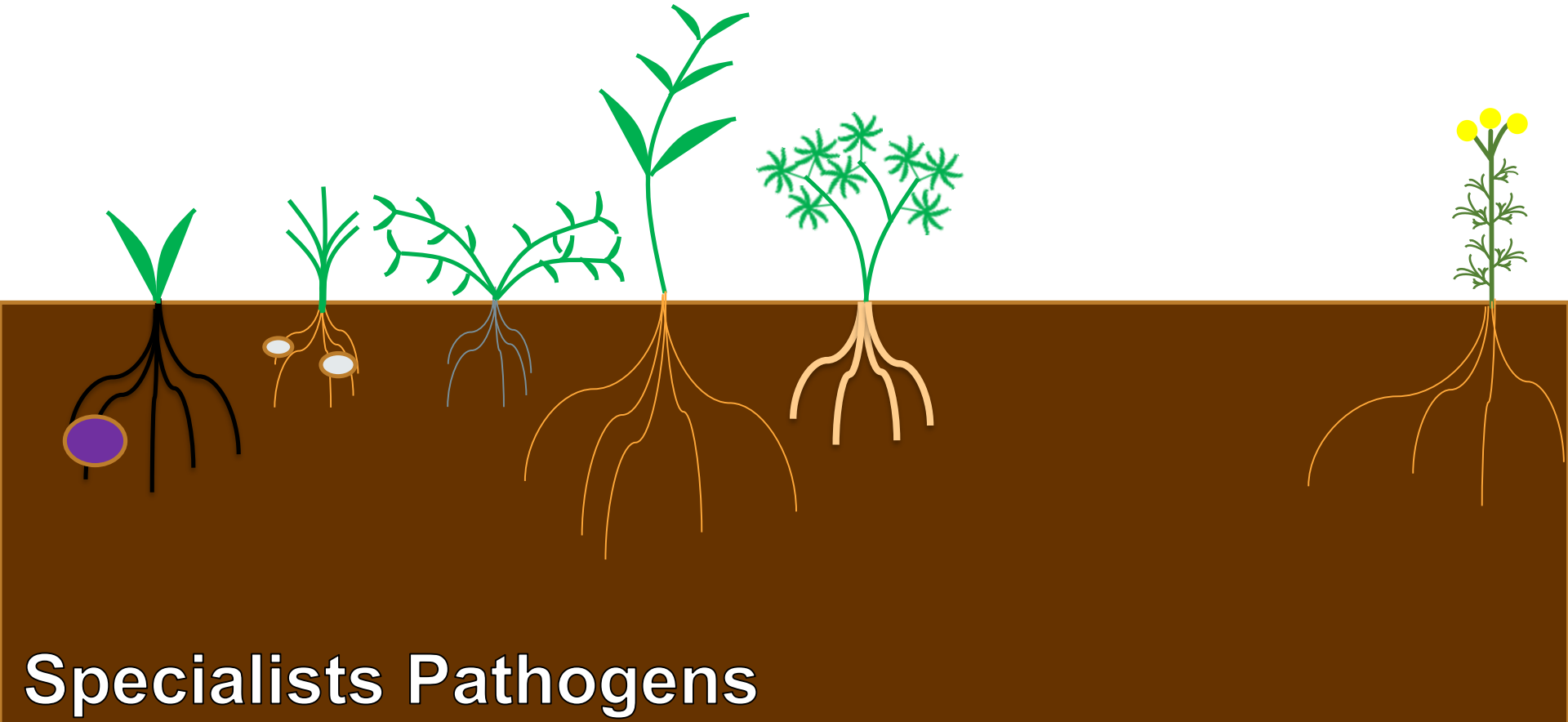
How degraded mutualisms may change



Pathogen Effects

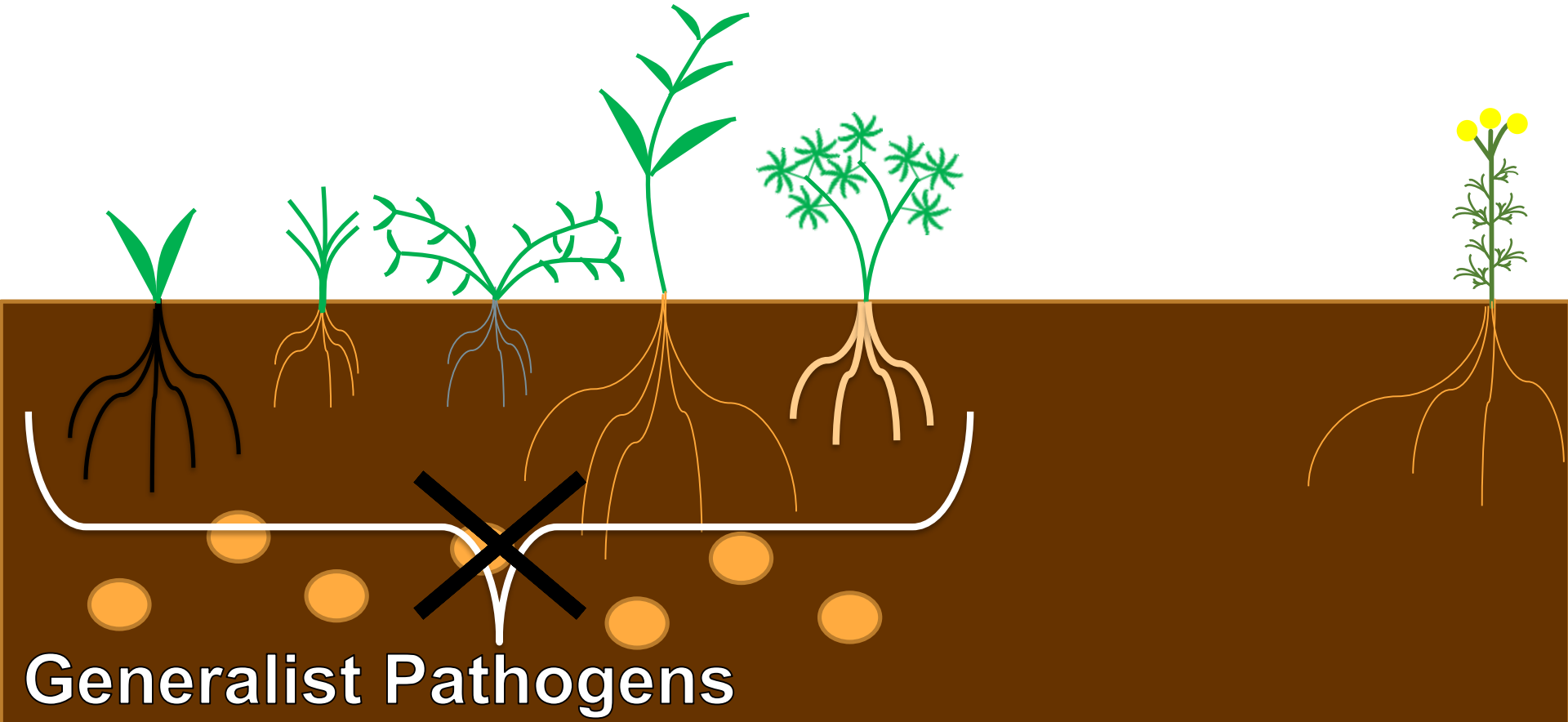


Pathogen Effects

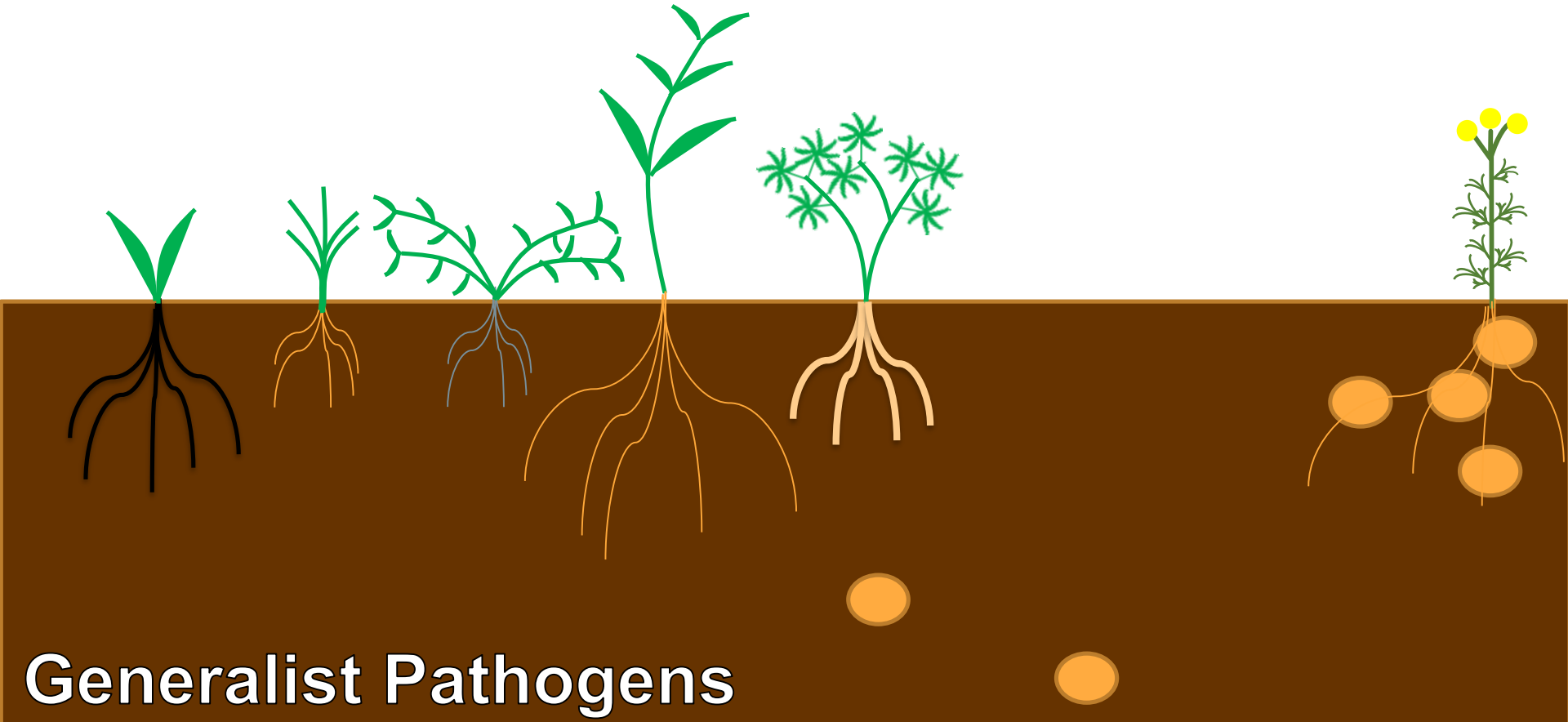


Specialists Pathogens

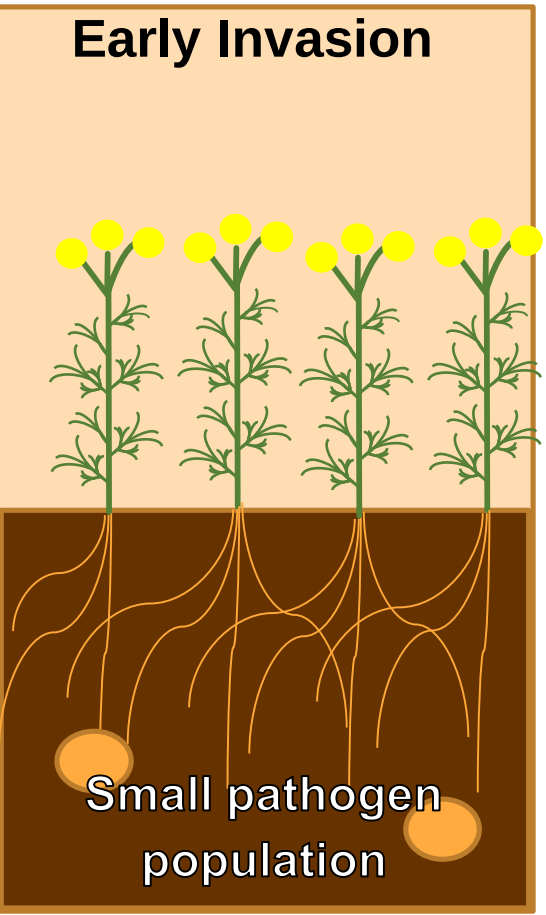
Pathogen Effects



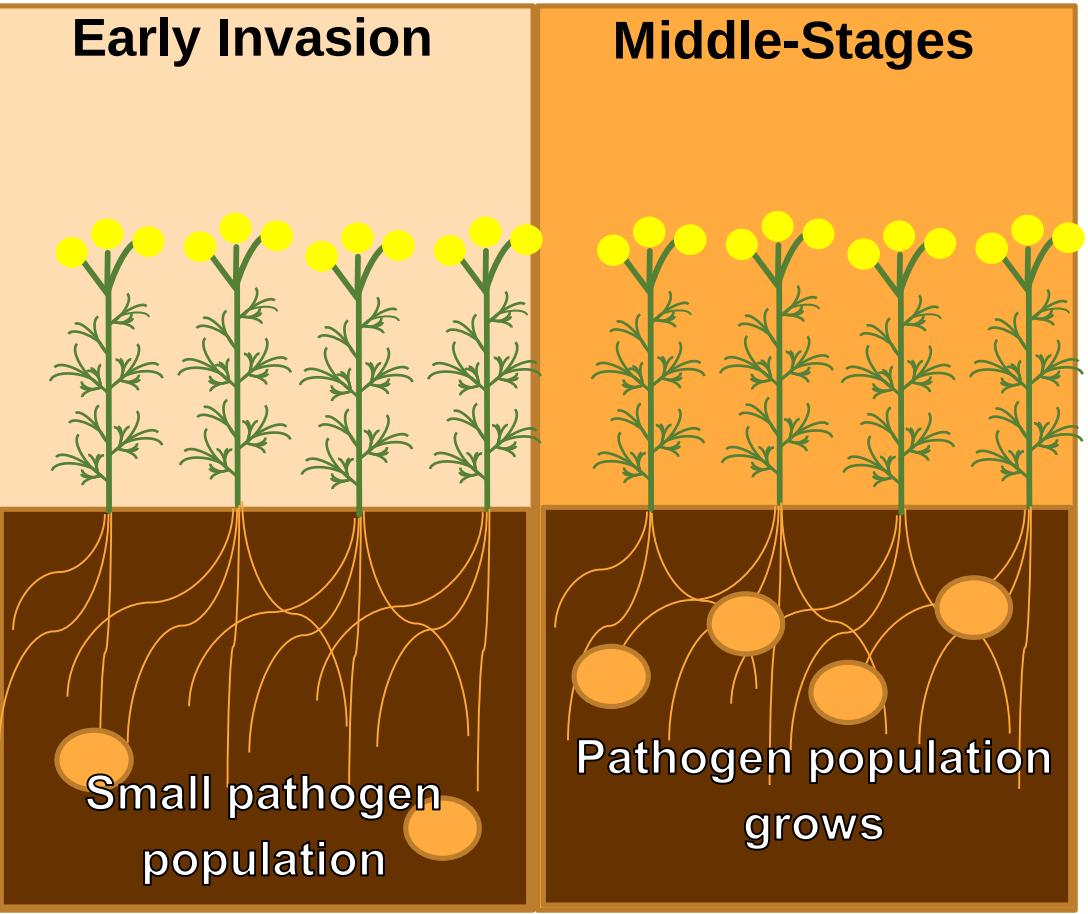
Pathogens



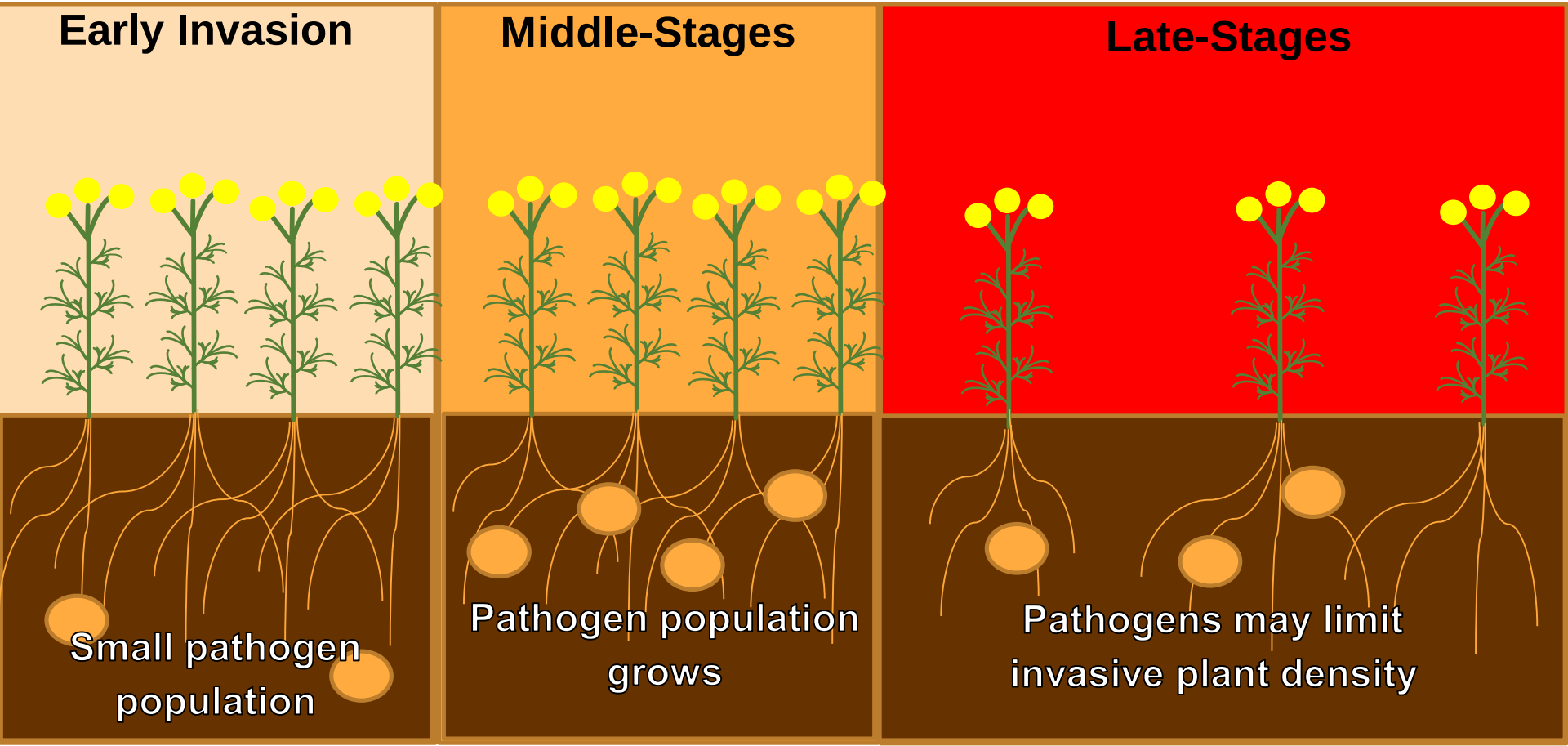
How generalist pathogen effects may change



How generalist pathogen effects may change



How generalist pathogen effects may change



Research Objectives & Hypotheses

Identify invasive soil legacies and how they inhibit native forb establishment

How do these legacies change through the course of invasion

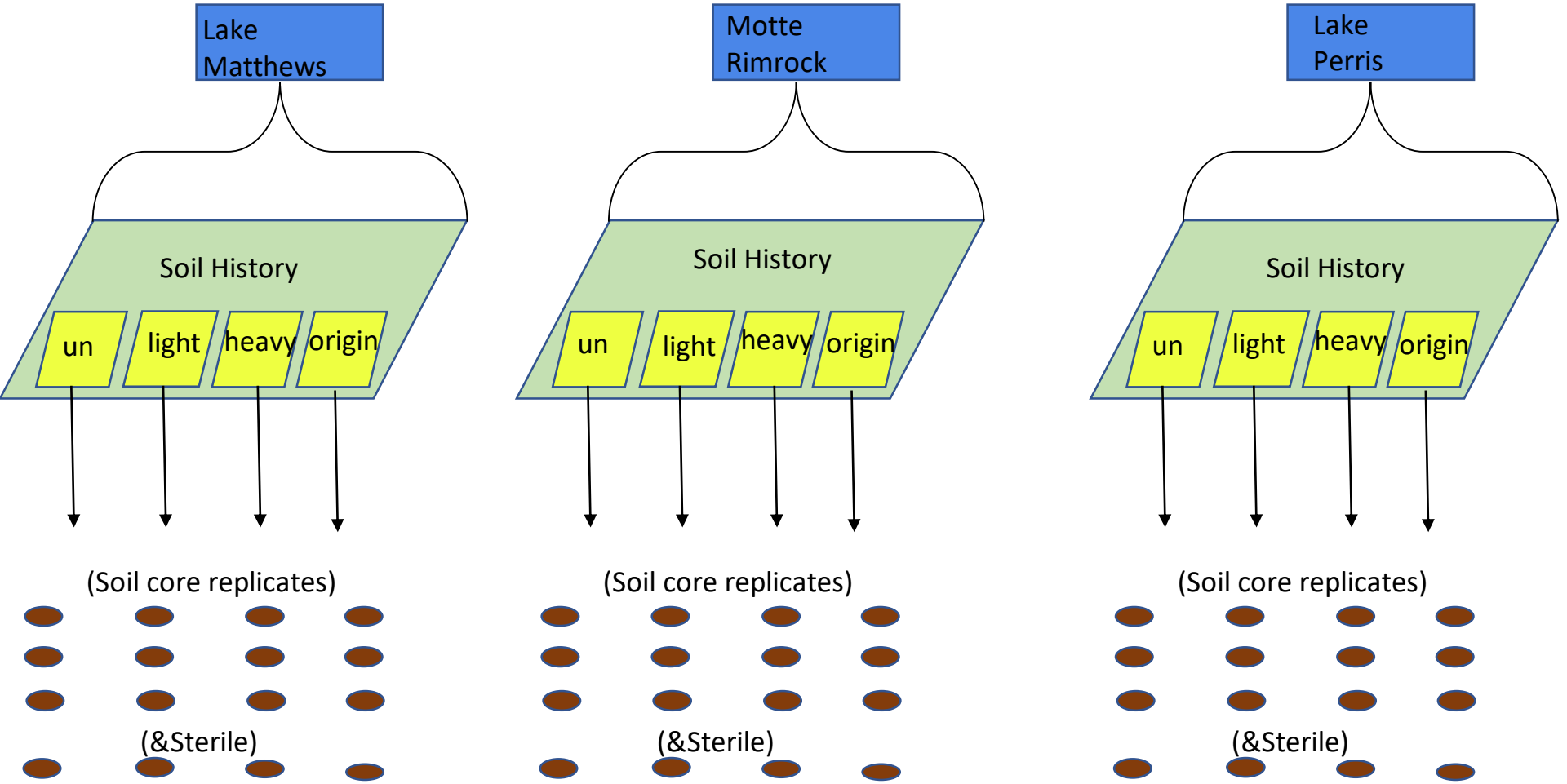
Hypotheses:

Enhanced mutualisms

Degraded mutualisms

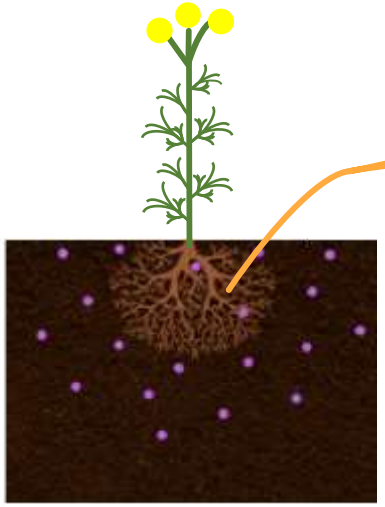
Pathogen loading


Lake Perris
Lake Matthews
Motte Rimrock
No Stinknet
Light Invasion
Heavy Invasion
Origin Point
N


Lake Matthews
Soil History
un
light
heavy
origin
(Soil core replicates)
(&Sterile)
Motte Rimrock
Soil History
un
light
heavy
origin
(Soil core replicates)
(&Sterile)
Lake Perris
Soil History
un
light
heavy
origin
(Soil core replicates)
(&Sterile)

Soil Legacies: Objectives and Greenhouse Design

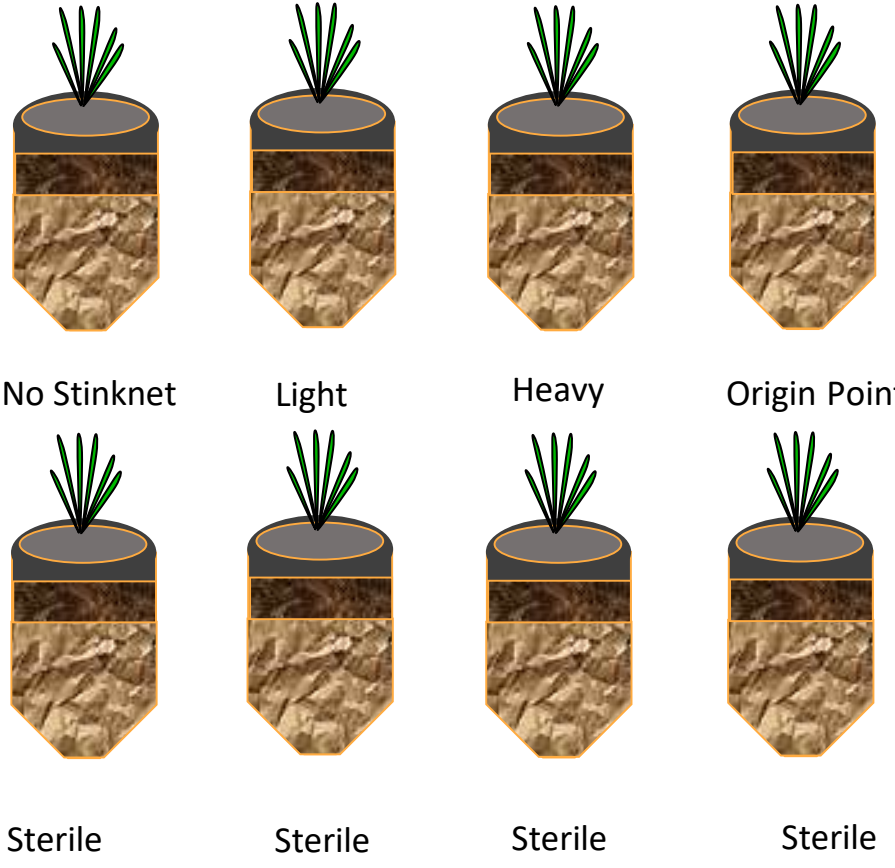
***Oncosiphon* Invasion Gradient**



Inocula

Sterile matrix soil
50:50 reserve and
UC sand mix

Reserve



Focal Plant Species

Layia platyglossa

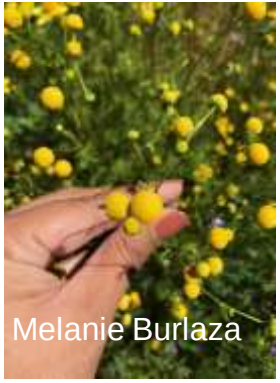
Lasthenia californica

Amsinckia intermedia

Eschscholzia californica

Lupinus bicolor

Nemophila menziesii



Oncosiphon piluliferum

Response Variables

Growth:
Shoot and Root biomass

Traits:
(SLA, SRL, Height)
Competitive and stress tolerance traits

Symbiosis:
Percent mycorrhizal colonization

Shoot Response Ratio

$$\frac{\text{Plant grown in live soil inocula} - \text{Plant grown in sterile soil inocula}}{\text{Plant grown in sterile soil inocula}}$$

Significant Responses

Standard least squares test:
Main effects:
Species, Reserve, Soil History
Two-way interactions
R^2=0.43 p<0.0001

Layia platyglossa

Lasthenia californica

Amsinckia intermedia

Eschscholzia californica

Lupinus bicolor

Nemophila menziesii

Oncosiphon piluliferum

Significant Responses

Least Squares Test Significant effects:
Reserve: p<0.0001
Species: p=0.005
Soil History: p<0.0001
Reserve*Soil History: p=0.0005
Species*Soil History: p=0.0363

Layia platyglossa

Lasthenia californica

Amsinckia intermedia

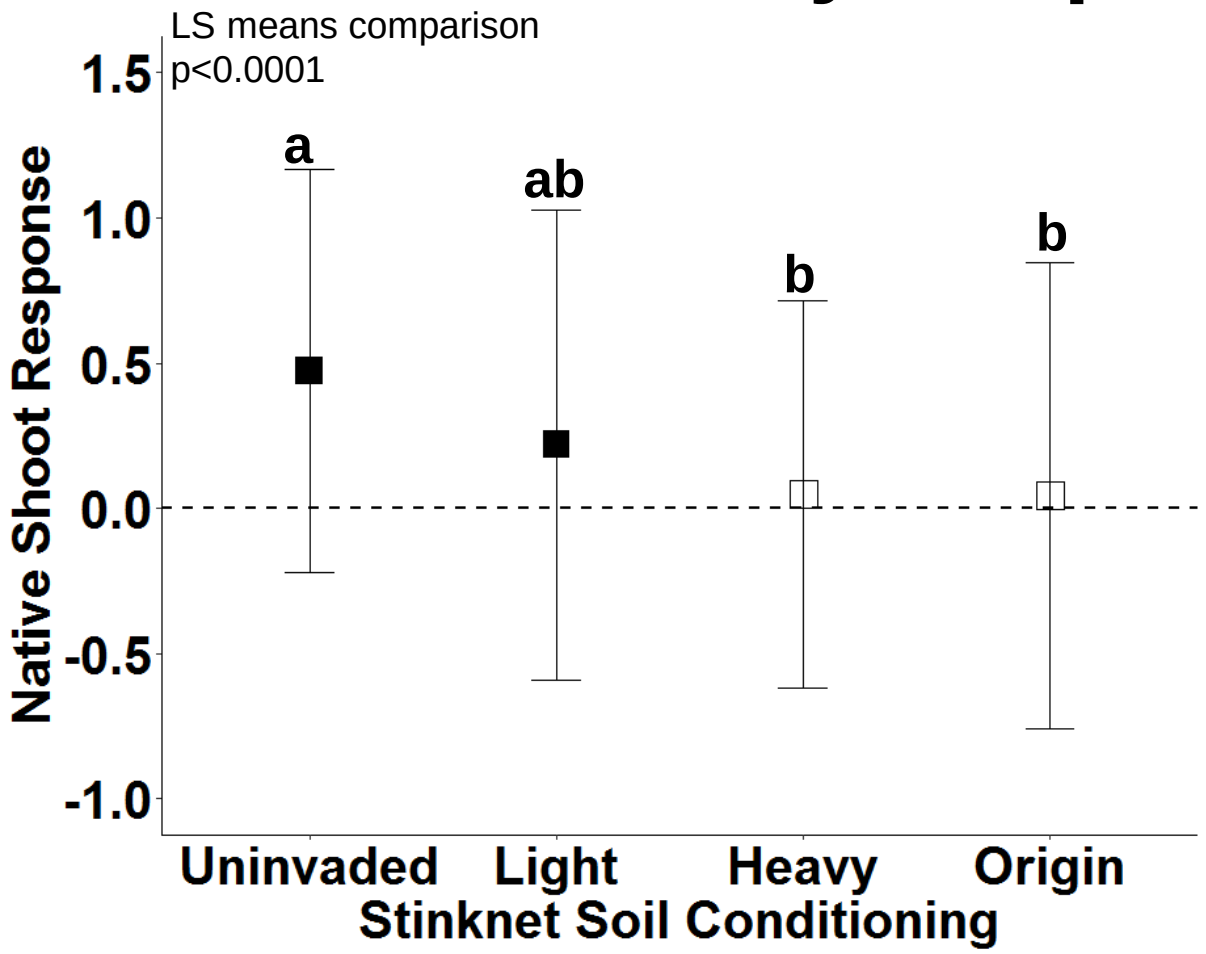
Eschscholzia californica

Lupinus bicolor

Nemophila menziesii

Oncosiphon piluliferum

Native Community Response



Significantly different from zero

Not significantly different from zero

Our results suggest:
Degraded Mutualisms mechanism

Degree of degradation affected by invasion stages

Species Responses

Layia platyglossa

Lasthenia californica

Amsinckia intermedia

Least Squares Test Significant effects:
Reserve: p<0.0001
Species: p=0.005
Soil History: p<0.0001
Reserve*Soil History: p=0.0005
Species*Soil History: p=0.0363

Eschscholzia californica

Lupinus bicolor

Nemophila menziesii

Oncosiphon piluliferum

LS means comparisons
p=0.0455

LS means comparisons
p=0.008

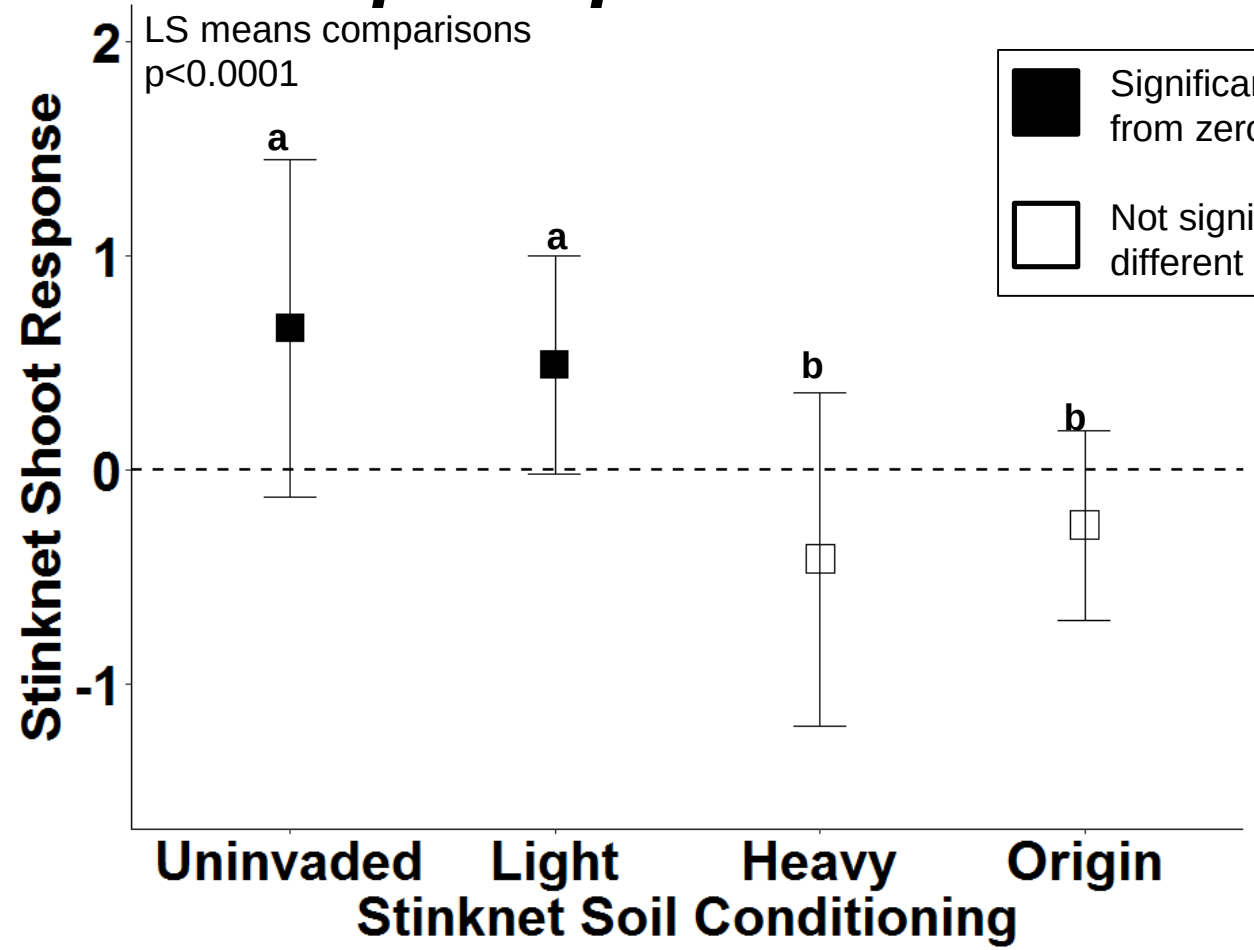
Lasthenia californica
Goldfields

Significantly different from zero

Not significantly different from zero

Nemophila menziesii
Blue Eyes

Oncosiphon piluliferum-Stinknet



Significant relationship

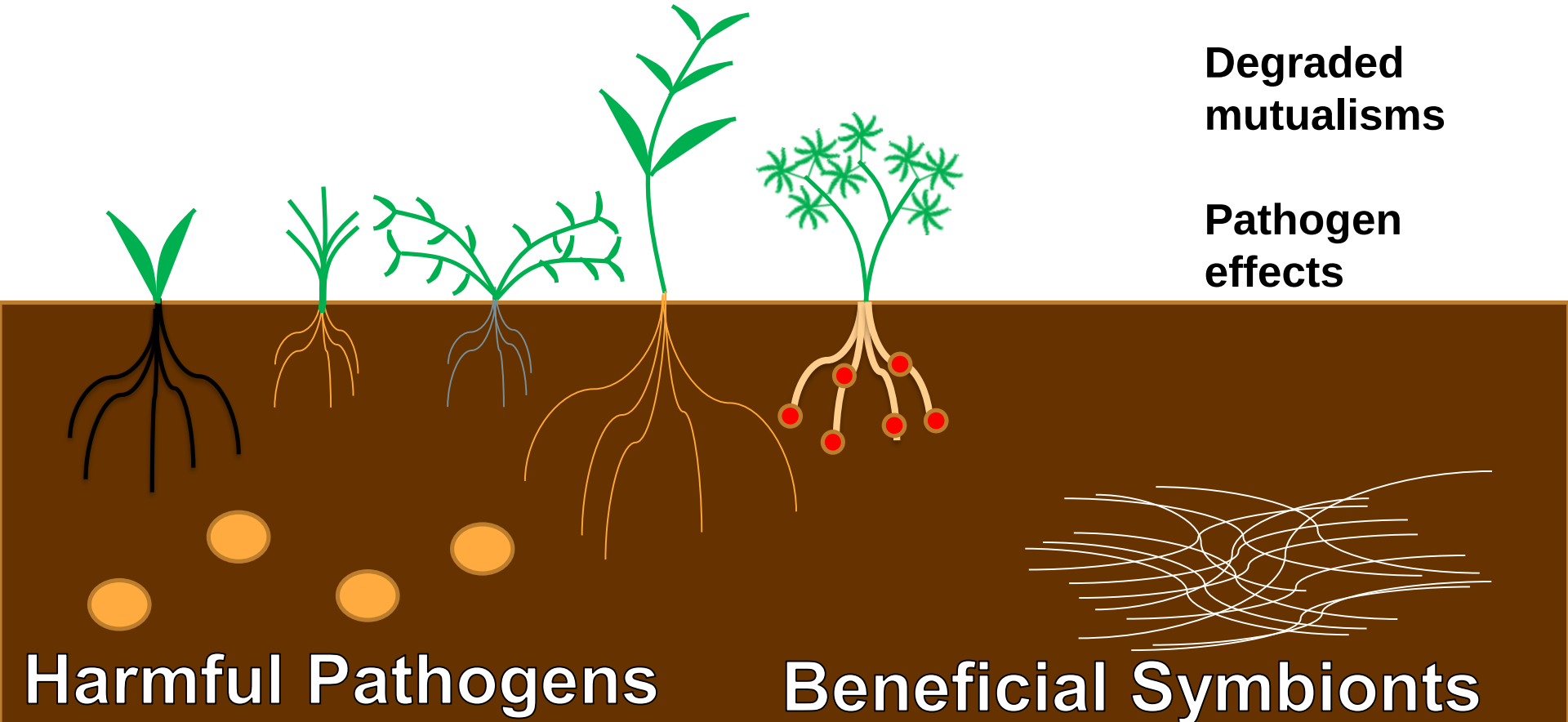
Negative response to its own soil conditioning

Feedback Mechanisms

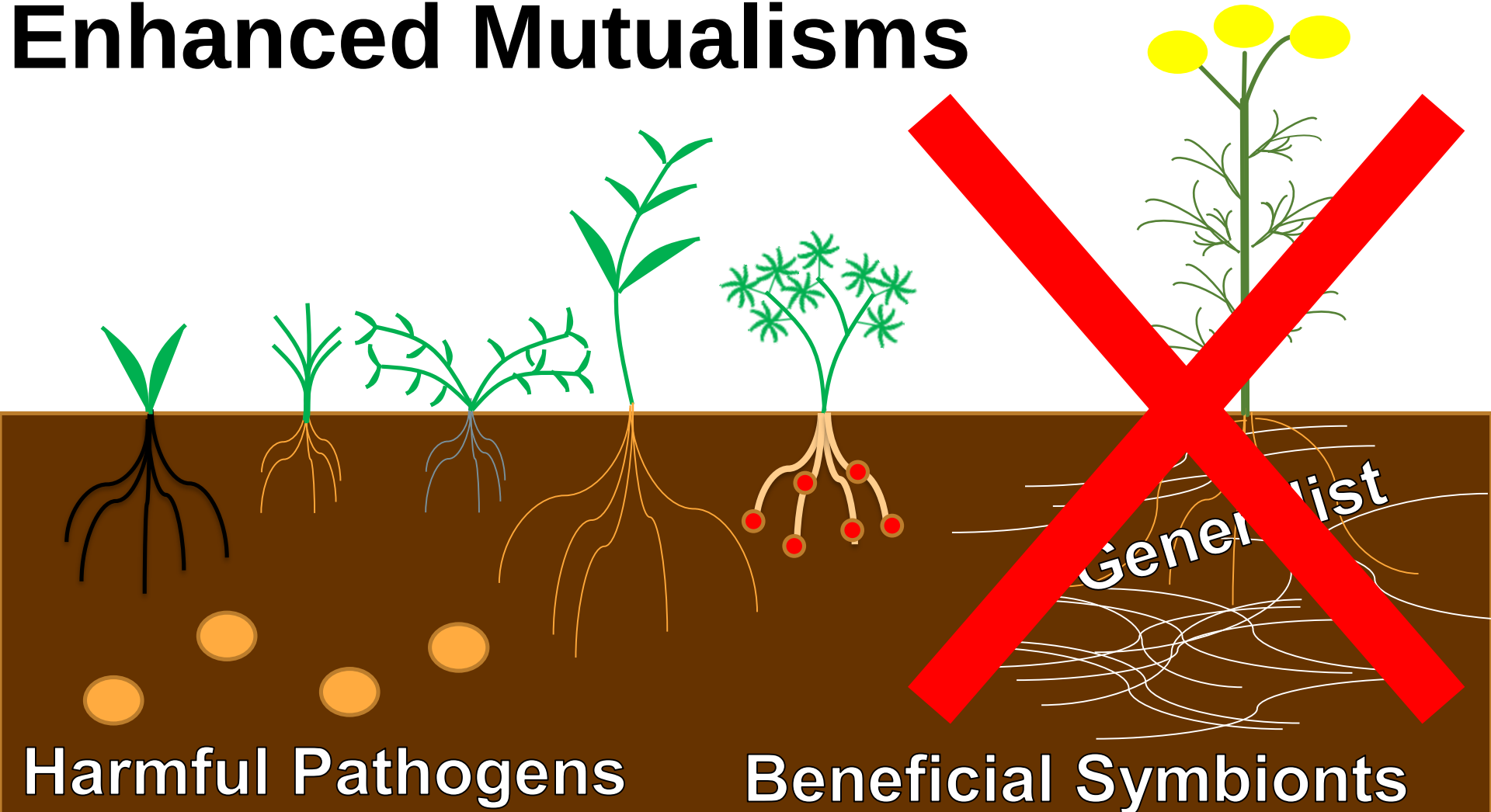
Enhanced mutualisms

Degraded mutualisms

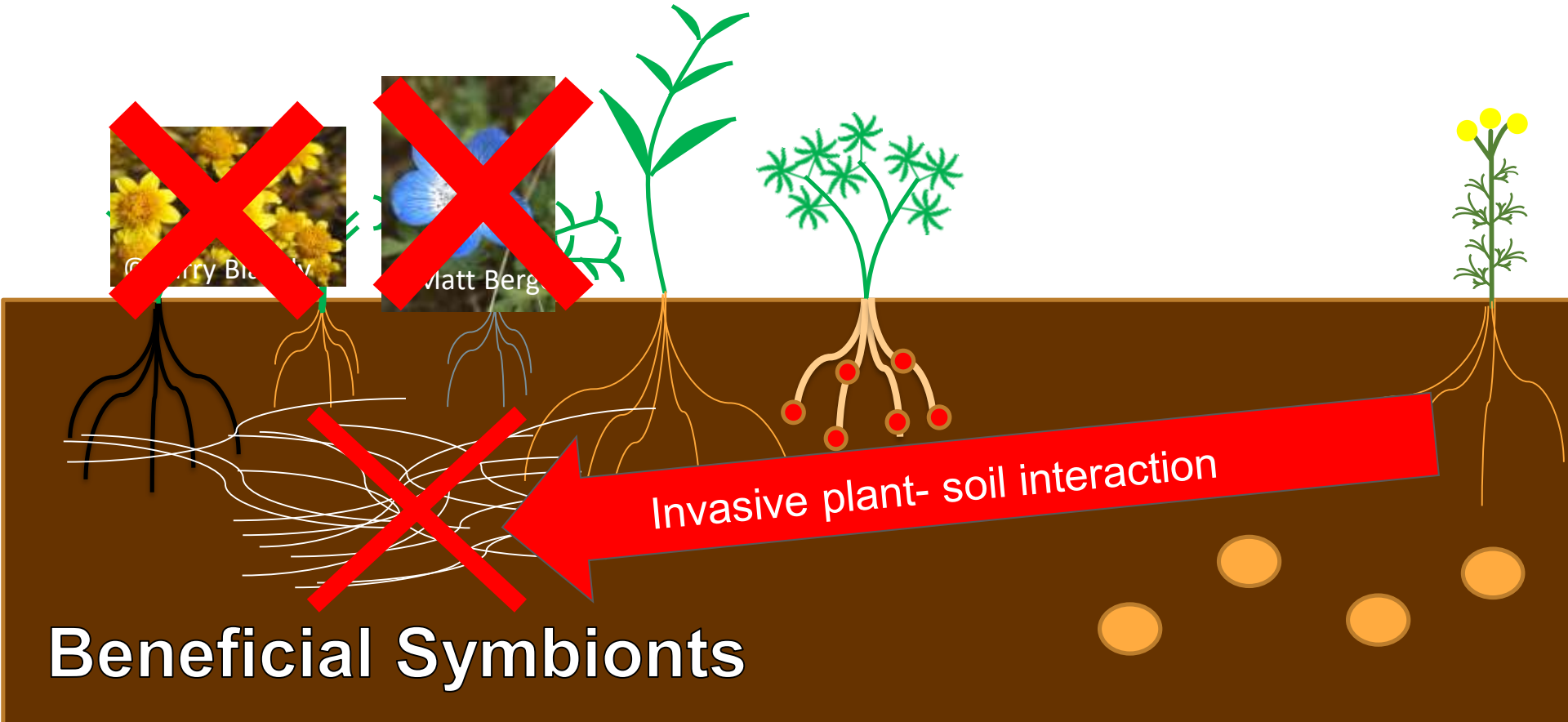
Pathogen effects



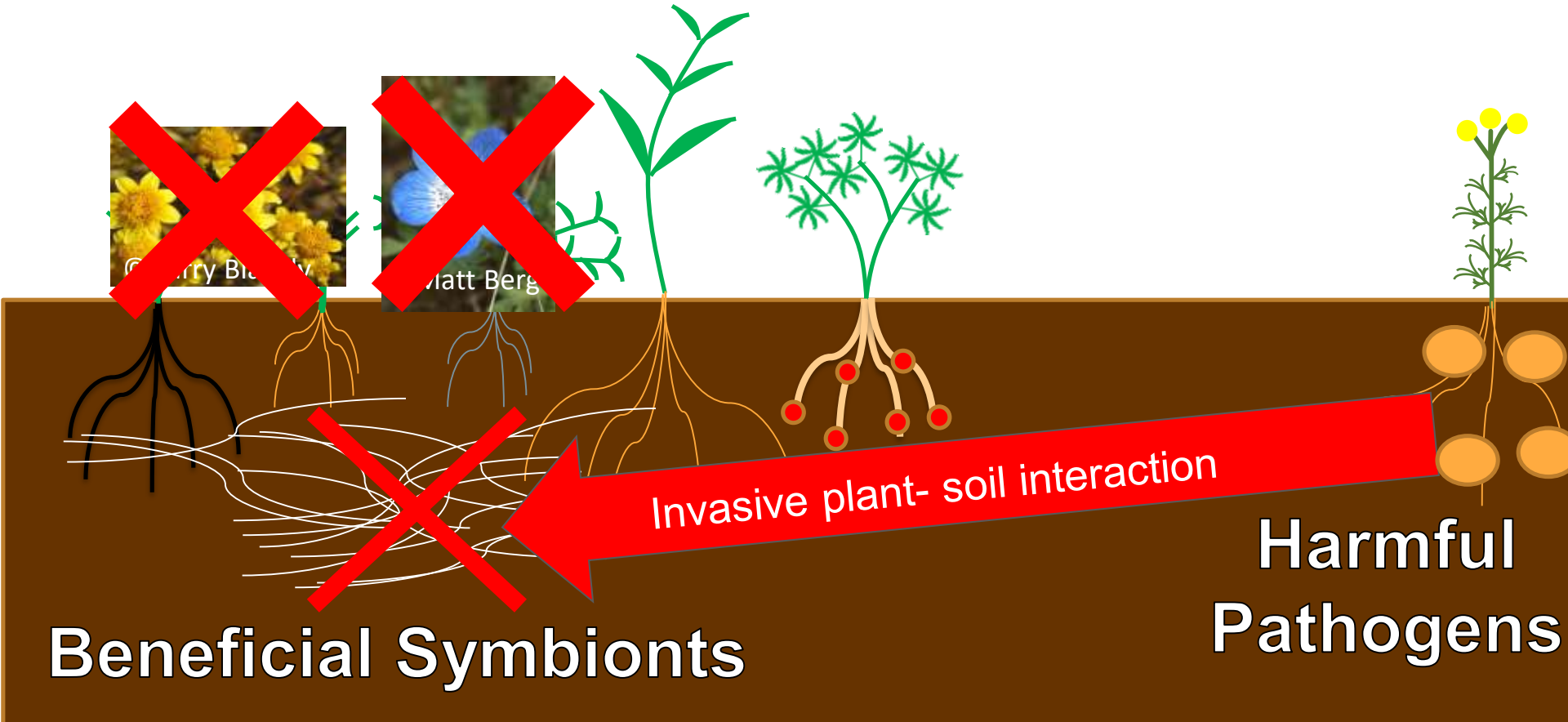
Enhanced Mutualisms



Degraded Mutualisms



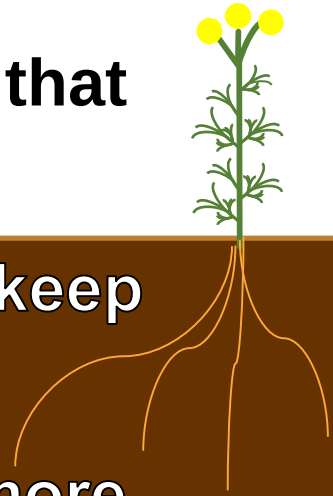
Degraded Mutualisms + pathogens



What's going on with these soil legacies?

1) Stinknet exhibits soil conditioning that inhibits native species

2) Stinknet may also be attracting pathogens that inhibit itself



Even after Stinknet has been removed- it can keep inhibiting native forbs

- Stinknet is likely inhibiting native species more than it is inhibiting itself

Our trends suggest invasion stage is important

Acknowledgements:

- Everyone in both Jenerette and Larios labs
- Jeff Diez (UCR)

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Lake Perris State Parks

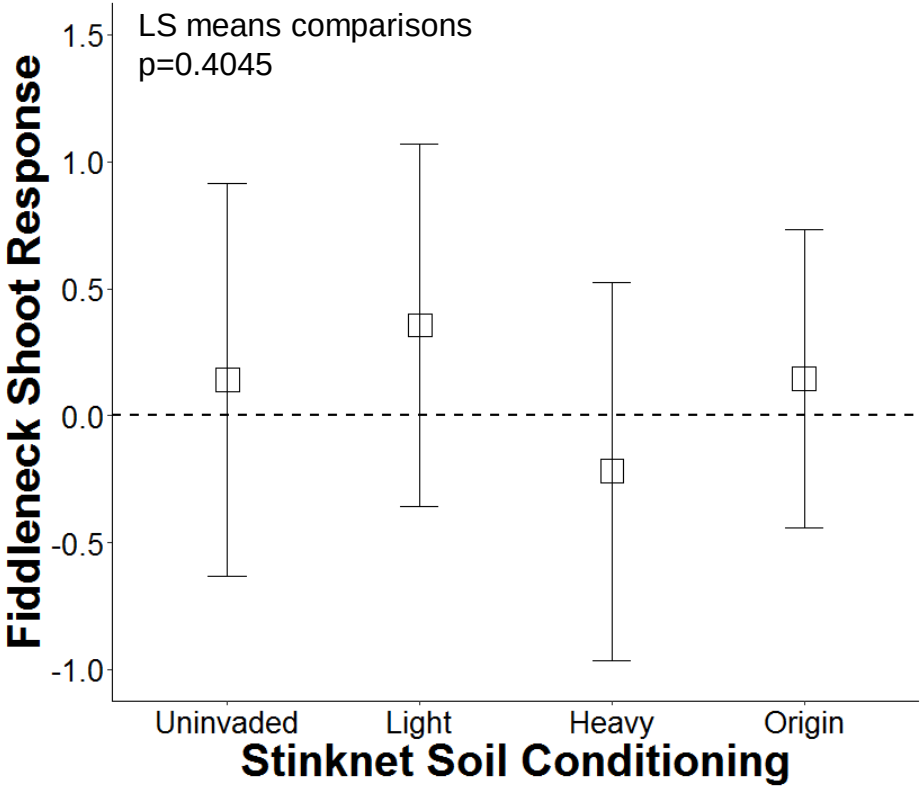
Lake Matthews- RCHCA

University of California Natural Reserve System Motte Rimrock (10.21973/N31T0W)

Funding:

Riverside Country Habitat Conservation Agency

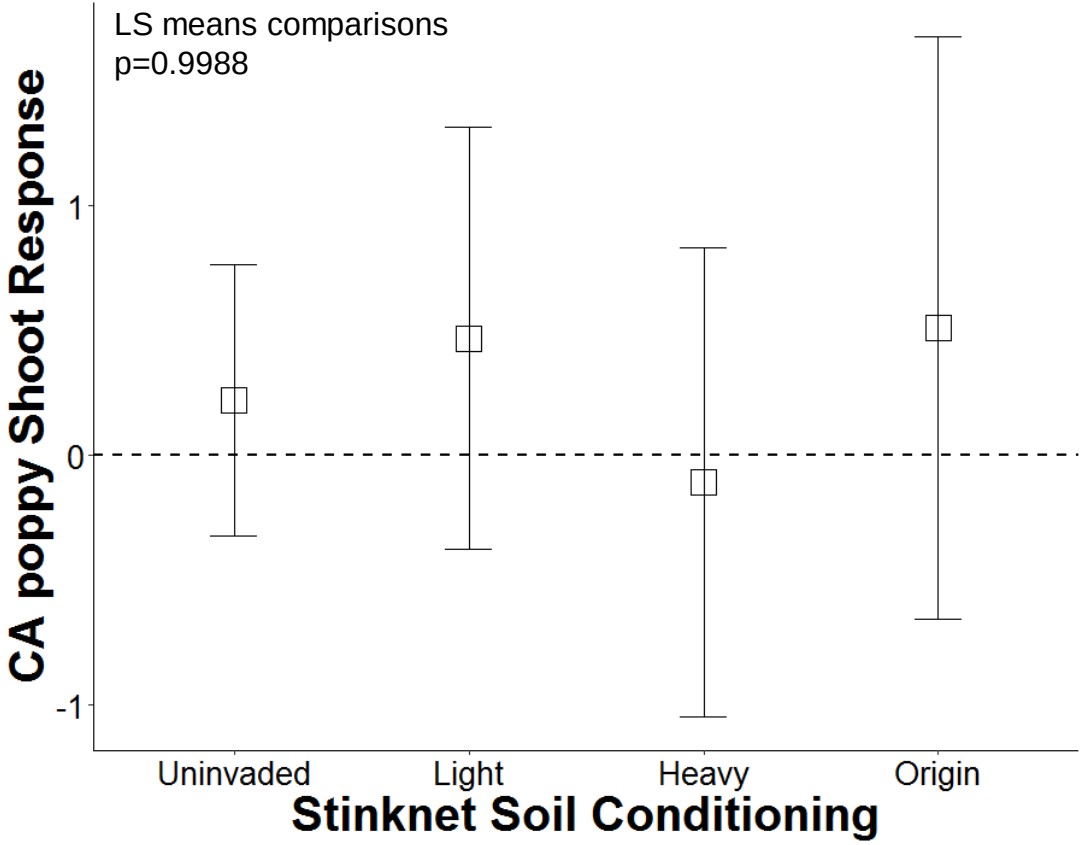
Amsinckia intermedia- common fiddleneck



No significant relationship

No evident trend with soil history

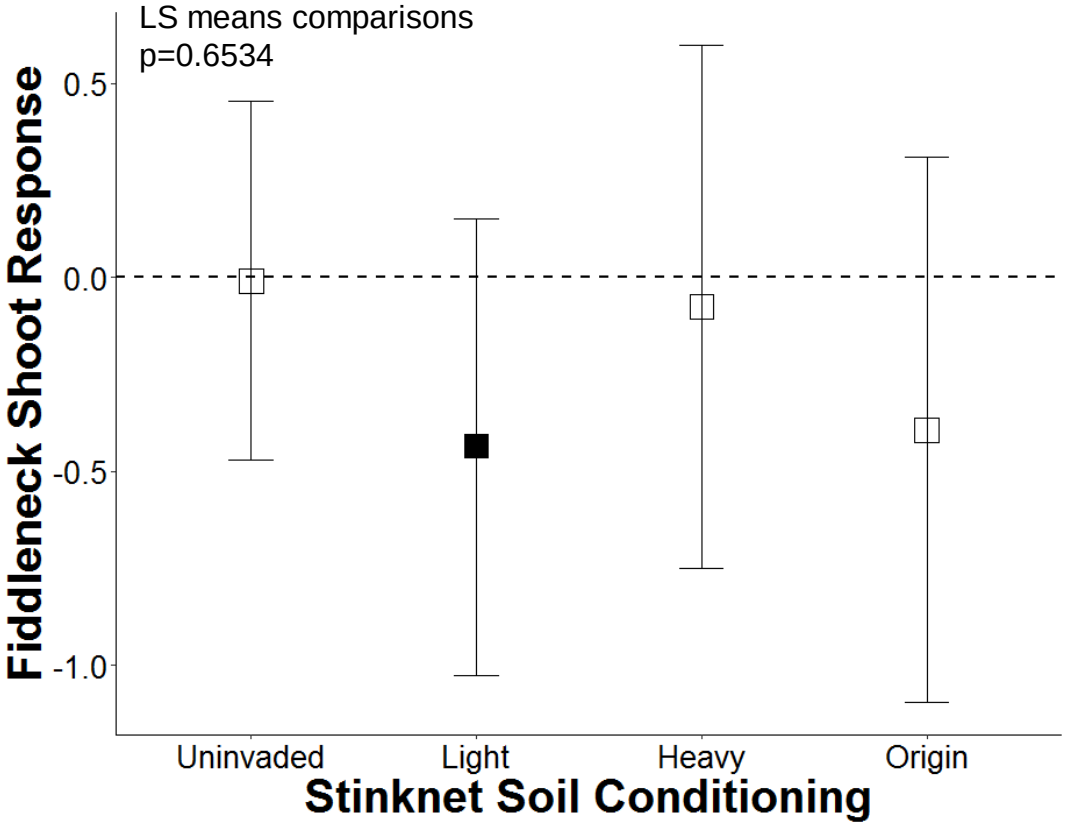
Eschscholzia californica- California Poppy



No significant relationship

No evident trend with soil history

Layia platyglossa- Coastal tidy tips

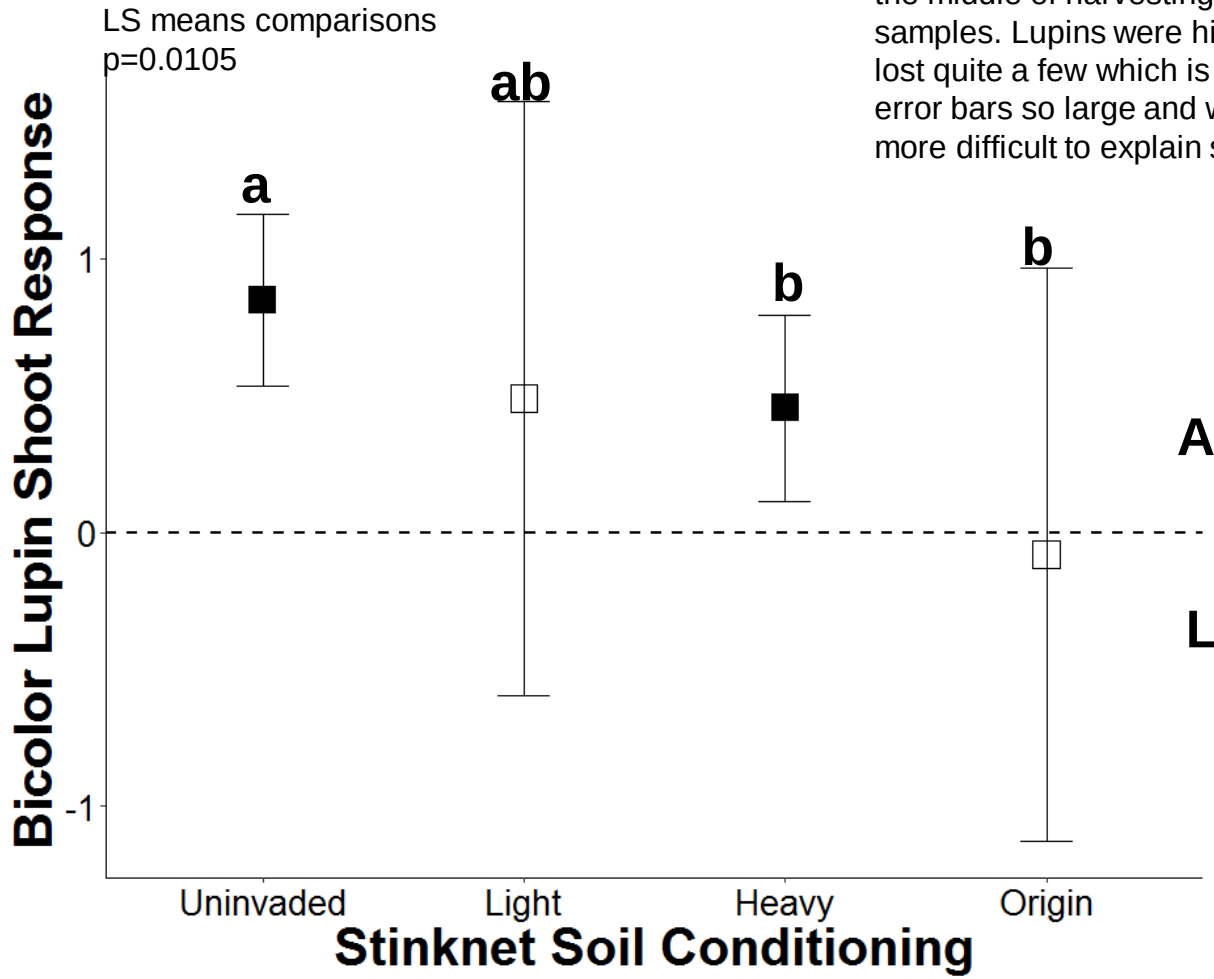


No significant relationship with soil conditioning

Appears to generally not like live soil

Lupinus bicolor- Bicolor lupine

*Riverside had a 105F heatwave right in the middle of harvesting 1000 random samples. Lupins were hit hard-so we lost quite a few which is partially why error bars so large and why trend is more difficult to explain statistically



Appears to be a negative trend

LSmeans comparison is significant

More complicated to interpret