Maternal effects in *Poa secunda*: harnessing plasticity for maximum success

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Outline

Background

What are maternal effects?

Examples of maternal effects

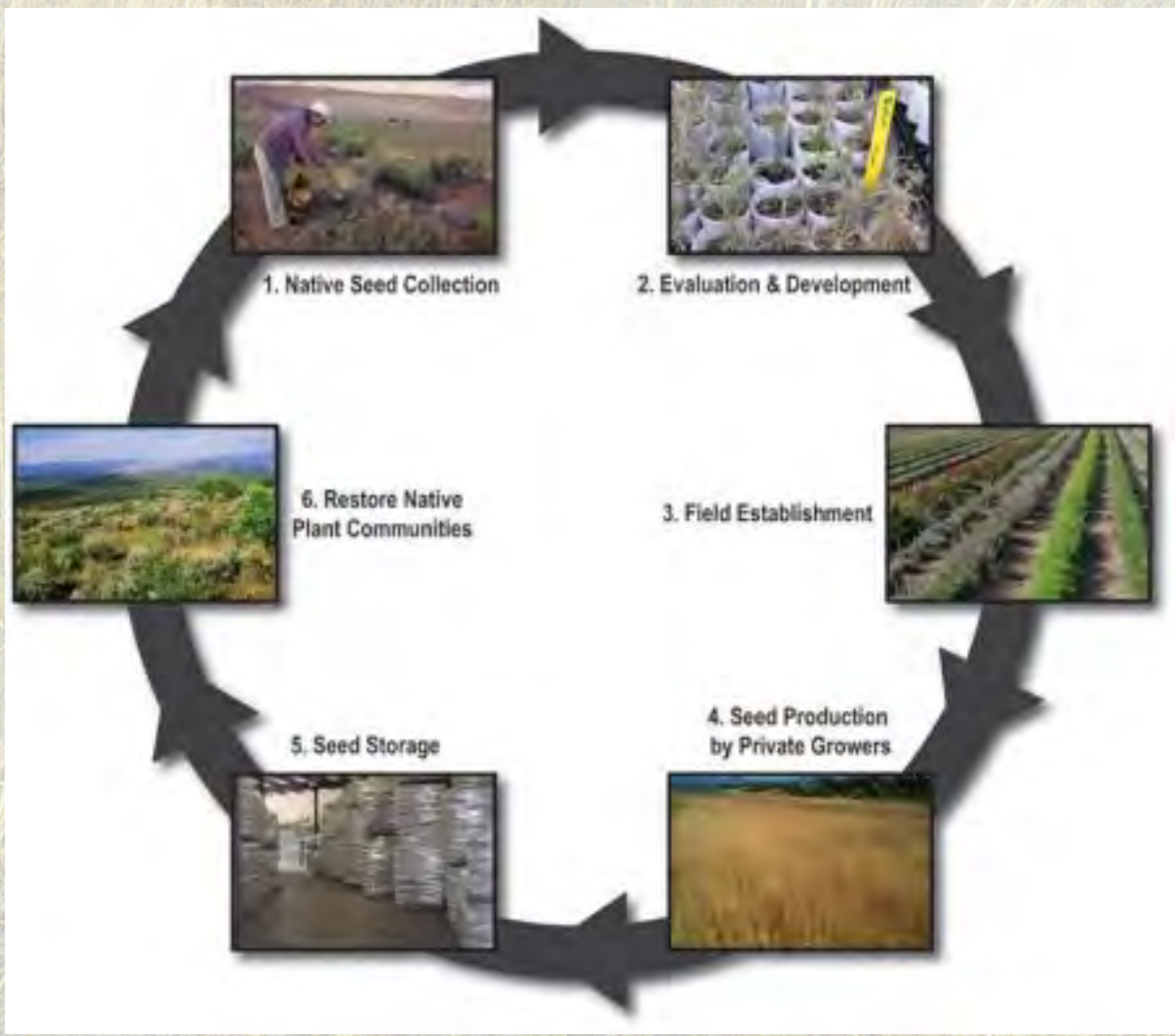
Specific research on *Poa secunda* (Sandberg's bluegrass)

Seed development process for maximum success

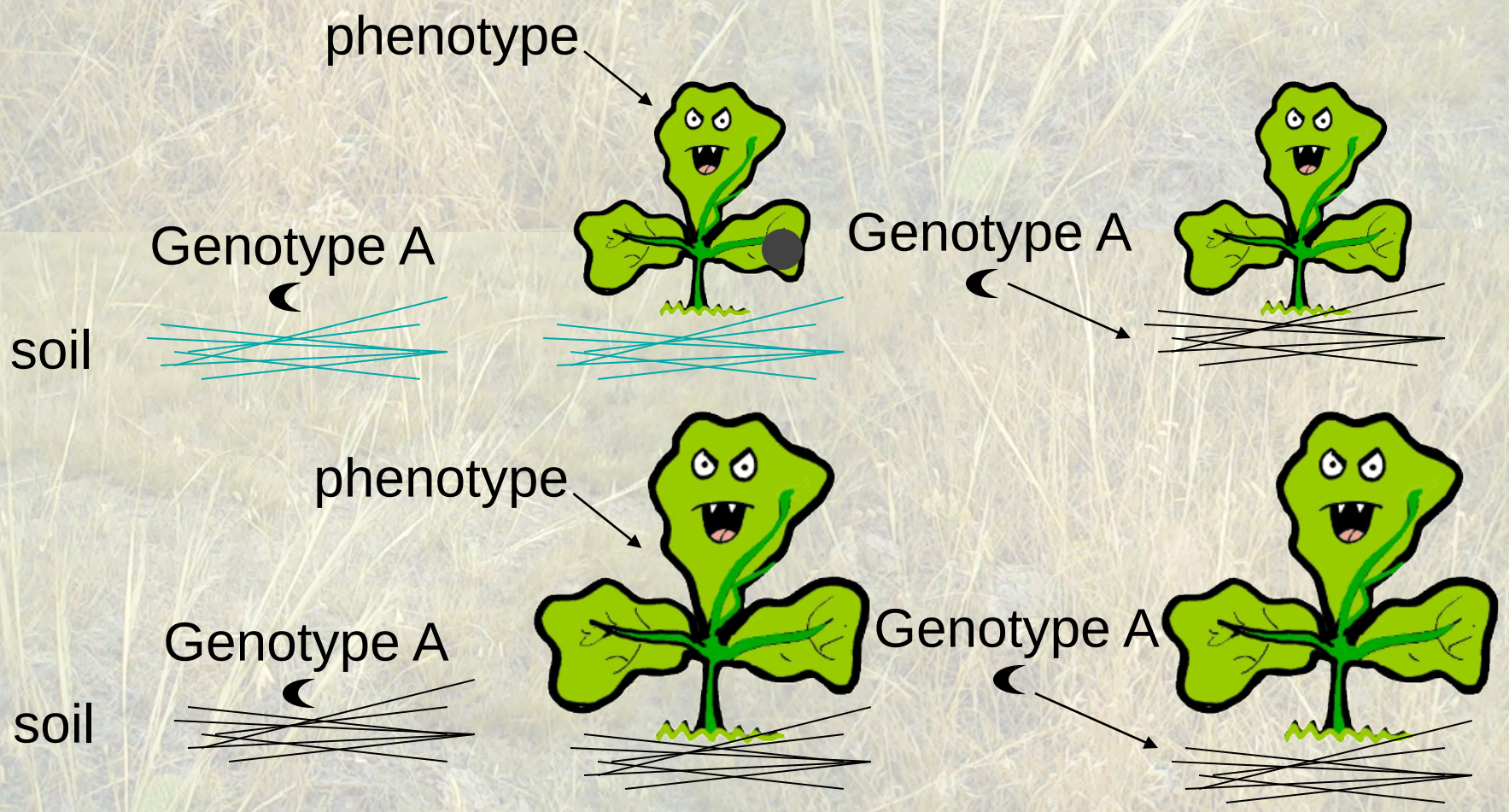
(1 year post-seeding)

There are may failures

Using plant materials to maximize success



Maternal environment affects progeny



Maternal environment affects progeny

- Two genetically identical moms growing in different environments will produce different-appearing progeny
- Paternal environment also affects progeny (transgenerational plasticity)
    - Etterson and Galloway 2002
- Maternal environment may be easier to manipulate and track

Drought tolerance

- Moms drought stressed
- Progeny grew faster below ground and more biomass when planted on dry sites (32% effect size)
- Mechanism: increased seed provisioning
- Application: drought stressed moms may lead to drought tolerant progeny

Polygonum
(Spotted ladysthumb)

Sultan et al. 2009 Ecology

Drought tolerance (flip side)

- Moms drought/edaphically stressed
- Progeny flowered earlier
- Mechanism: **decreased** seed provisioning
- Application: drought stressed moms may lead to drought tolerant progeny

goatgrass

Dyer et al. 2010 Evol. Apps.

Herbivory tolerance

- Herbivorized moms
- Progeny tolerate herbivory better
- Mechanism: higher concentrations of defensive chemicals
- Application: grazing/herbivory may be used to create grazing/herbivory tolerant materials

Wild radish

Agrawal 2002 Science, Agrawal et al. 2009 Nature

Seed development process

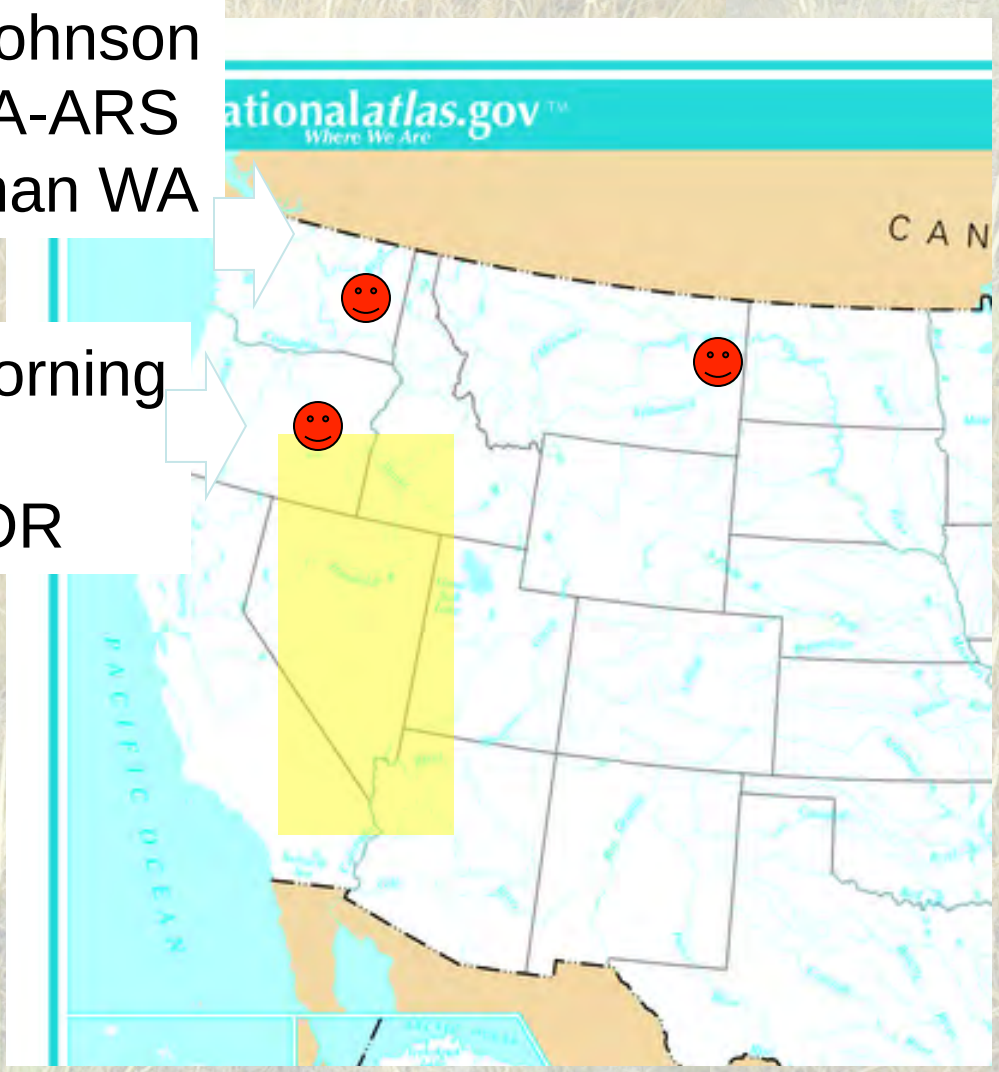
Research on *Poa secunda*

- Adaptive maternal effects in
  - Germination
  - Growth
  - Competition from cheatgrass
    - Work beginning this year

Genecology of *P. secunda*

RC Johnson
USDA-ARS
Pullman WA

Matt Horning
USFS
Bend OR



Seeds collected from Great Basin (yellow)

Plants grown in three gardens (red)

Do plants from similar habitats share similar traits?

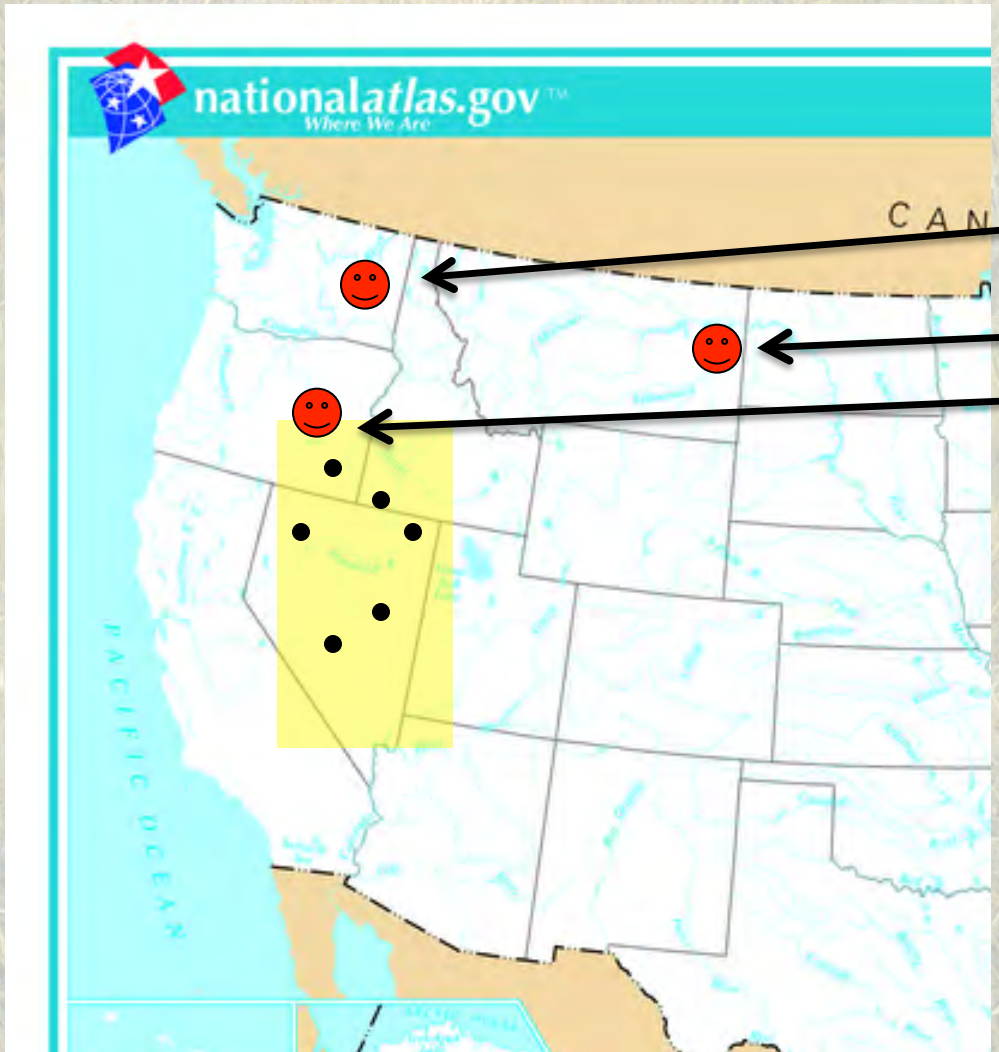
Garden locations

WA

OR

MT

Use this for TGP* research



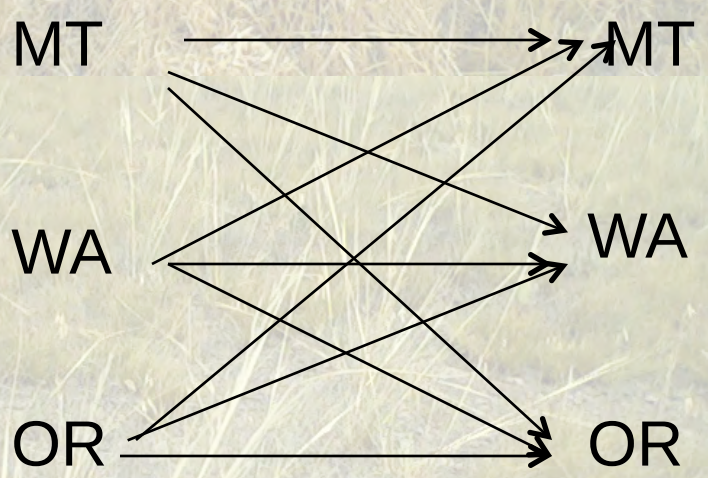
Take seeds from same genotypes grown in three gardens, grow under different temperature regimes

* Transgenerational plasticity

Germination experiment

Grown in temps reflecting

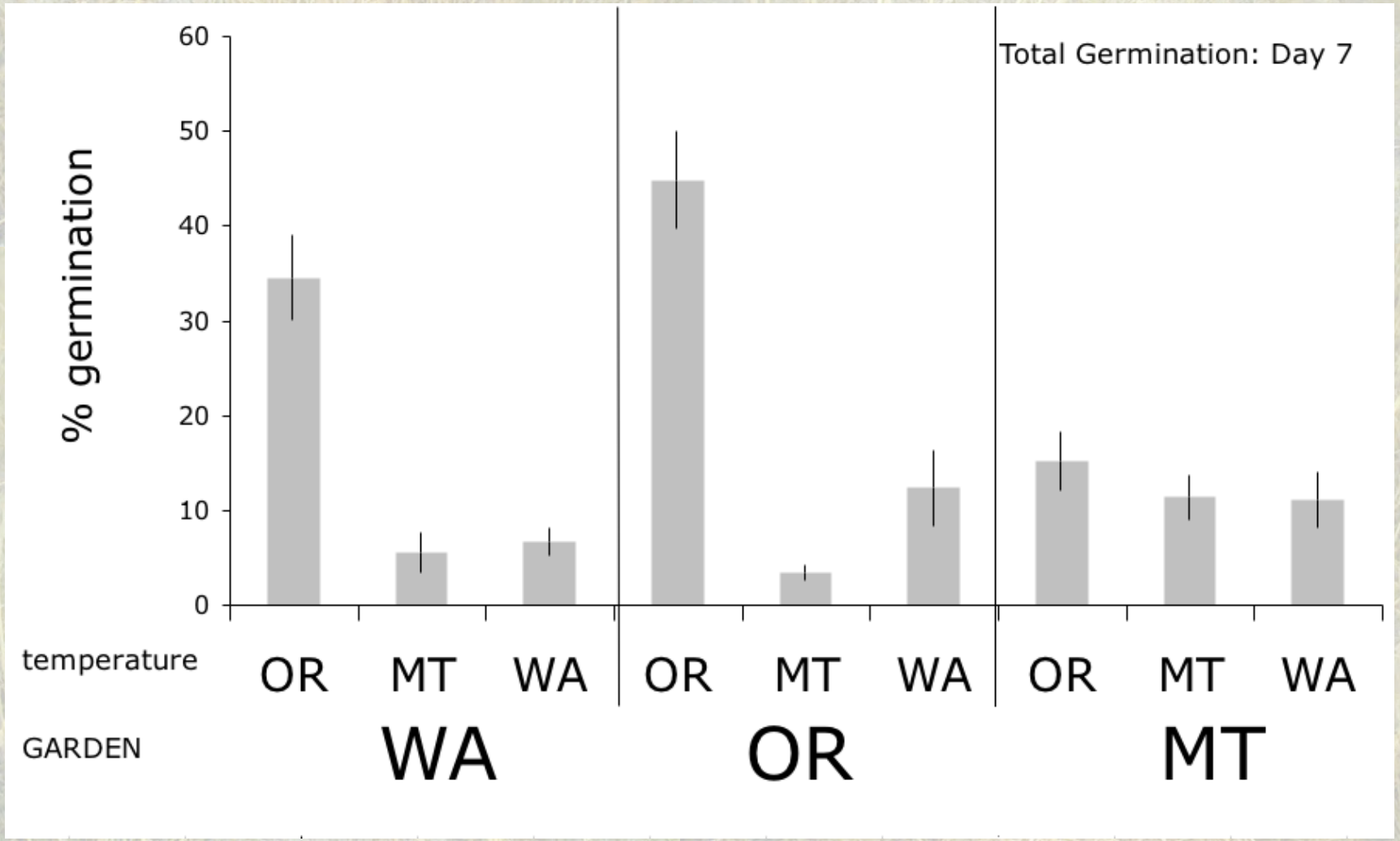
Seeds from



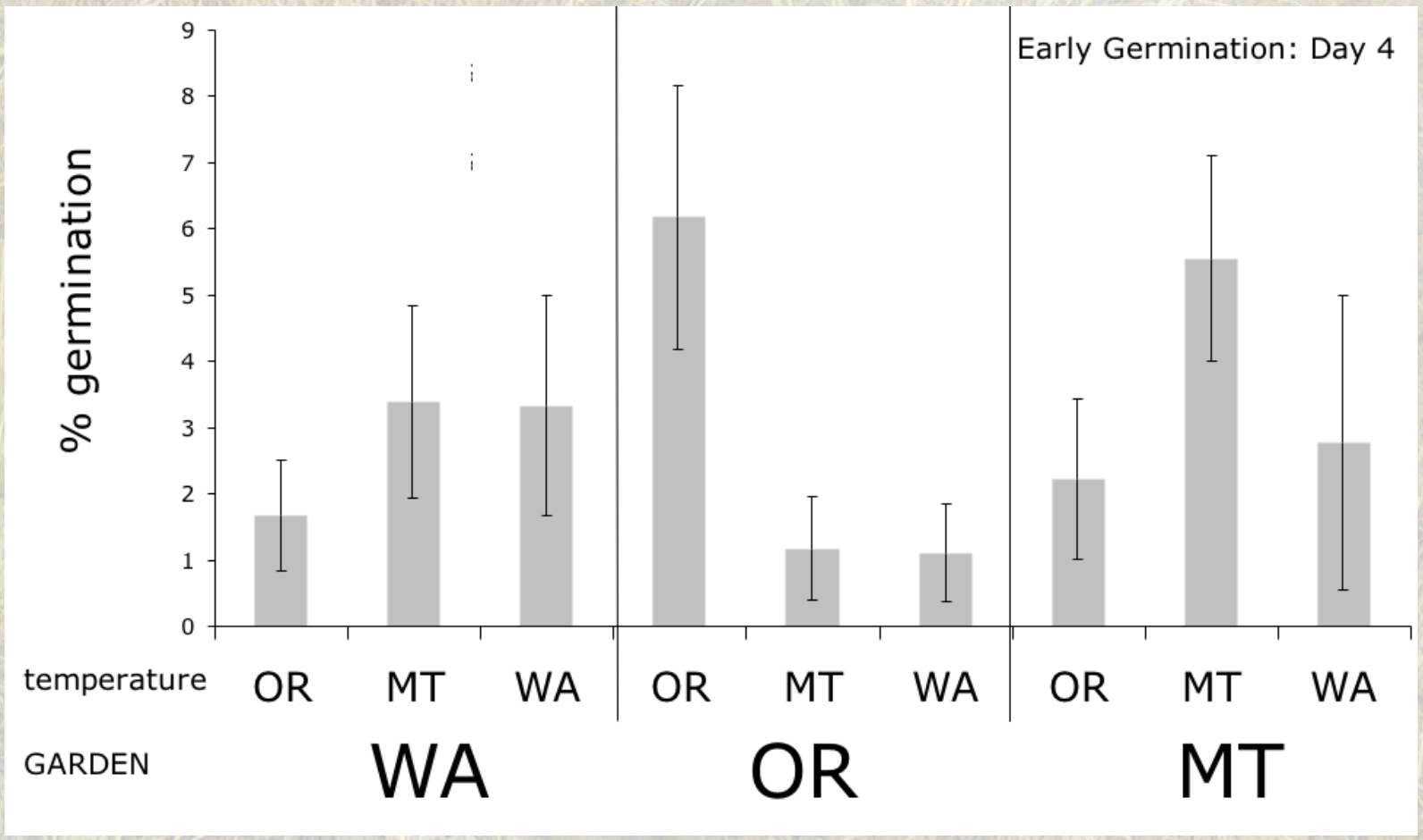
Do seeds perform better under maternal conditions?

This was a lot of seeds!

No adaptive TGP found in total germination



Adaptive TGP found in EARLY germination



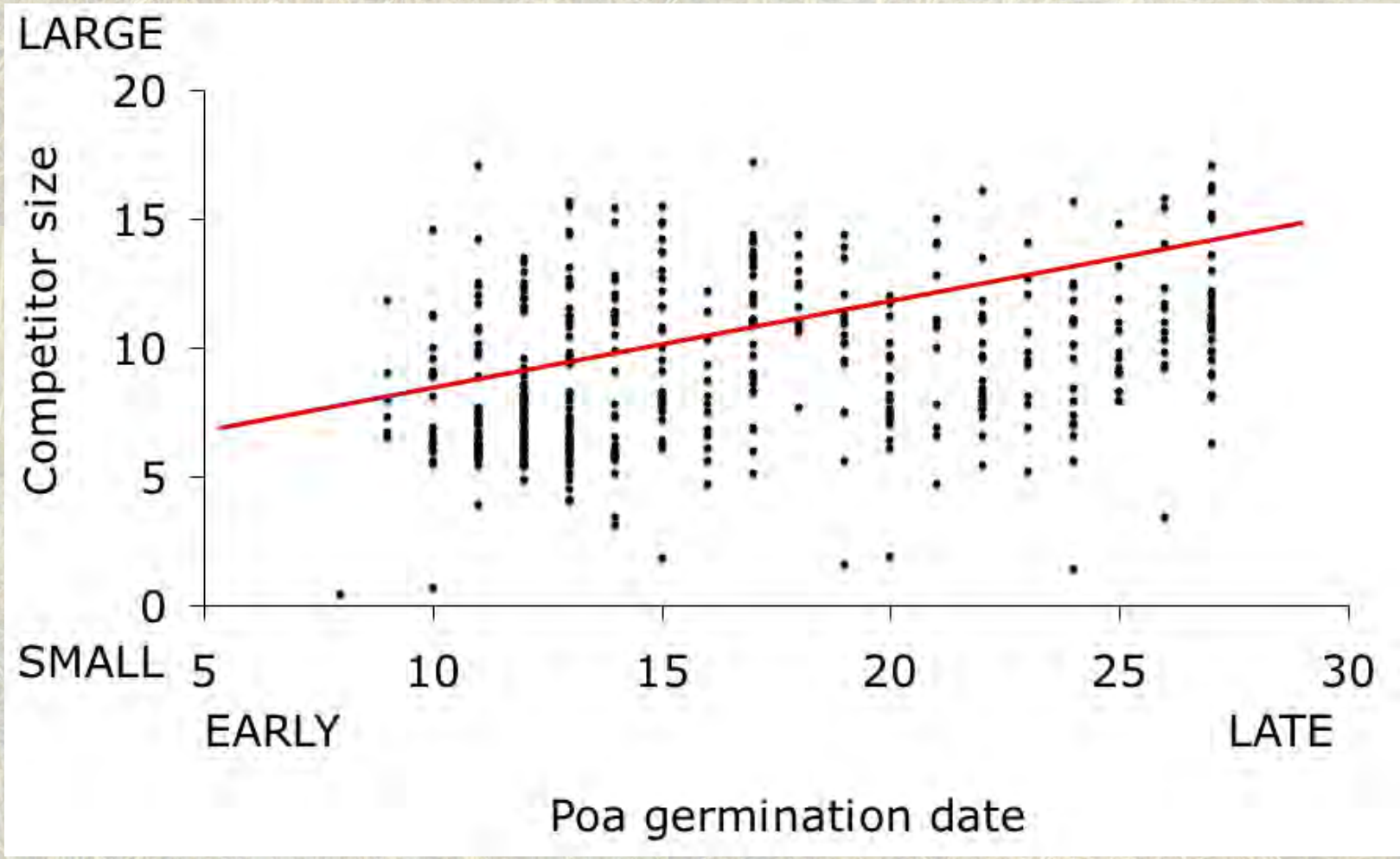
Why germinate fast?

- Escape predation
- Start growth earlier
  - Get bigger
  - Get ahead of your competitors
- Is this true for *P. secunda*?

Growth experiment

- Do adaptive TGP effects mean that seeds will be more competitive?
- Growth chamber experiment
  - In pots with light/dark cycles
  - April temperatures
    - Simulated three gardens
  - Two soil types
  - Cheatgrass or
  - Crested wheat

Earlier germination = less competitor growth



Summary so far

- Adaptive maternal effects occur in germination rate
  - Locally-grown is better
- Germination rate improves competitive ability
  - Faster germination means smaller competitors

Forthcoming work

- TGP and competitive environment
  - Adaptive TGP in *P. secunda* with cheatgrass competition?
- Do seeds grown in agronomic conditions perform differently than wild-collected seeds?
  - Western wheatgrass
  - Green needlegrass

Incorporate research into roadside hydroseeding: western wheatgrass and green needlegrass

Agronomically-grown vs. wild-collected

Does one generation of agronomic grow-out affect seed performance?

Western wheatgrass

Green needlegrass

How does one generation of agronomic grow-out affect seed performance?

Western wheatgrass

Green needlegrass

Let’s get quantitative

- Two groups have done agronomic vs. wild-grown comparisons
  - Population sources were different
- Findings: agronomically-grown had
  - Better establishment
  - Less drought tolerance
  - Less persistence
- Forthcoming study of Kulpa et al.

Let’s use the findings to maximize seed performance!

Western wheatgrass

Green needlegrass

Maternal effects and the seed development process

Acknowledgements

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