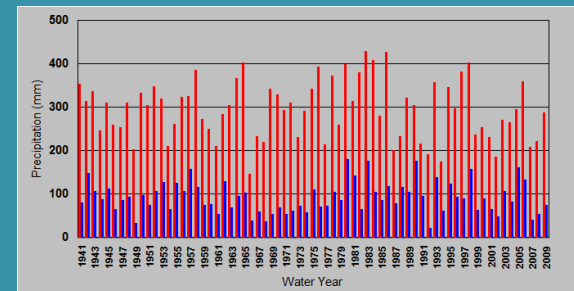
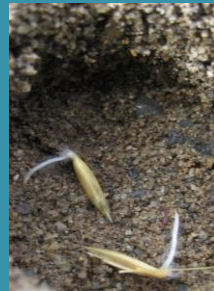
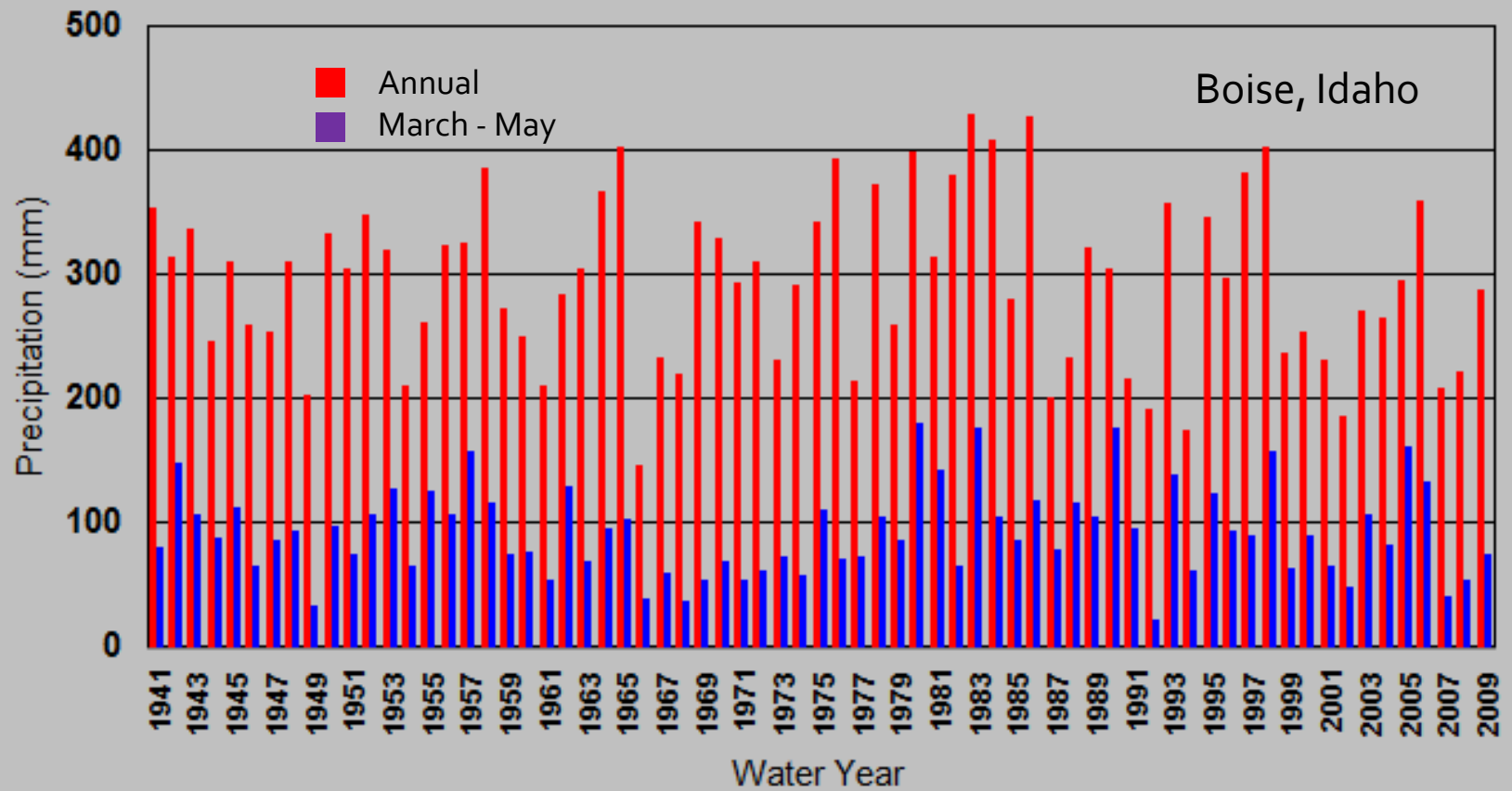


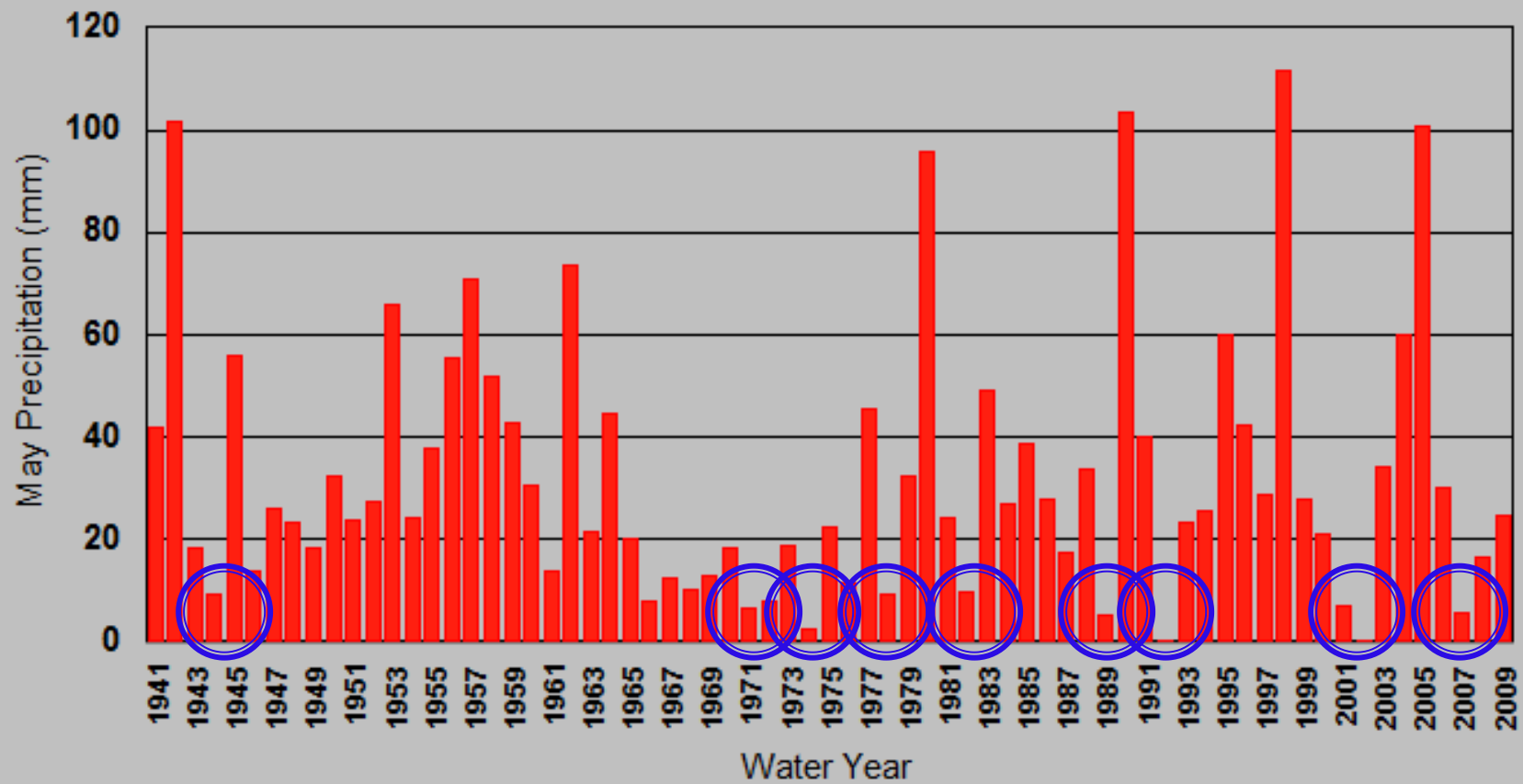


The role of germination (**rate**) in early plant establishment: Characterization of germination syndromes in a highly variable field environment



Stuart Hardegree, Corey Moffet, Christine Walters and Roger Sheley
USDA Agricultural Research Service







Seed



Germinated seed



Emerged seedling



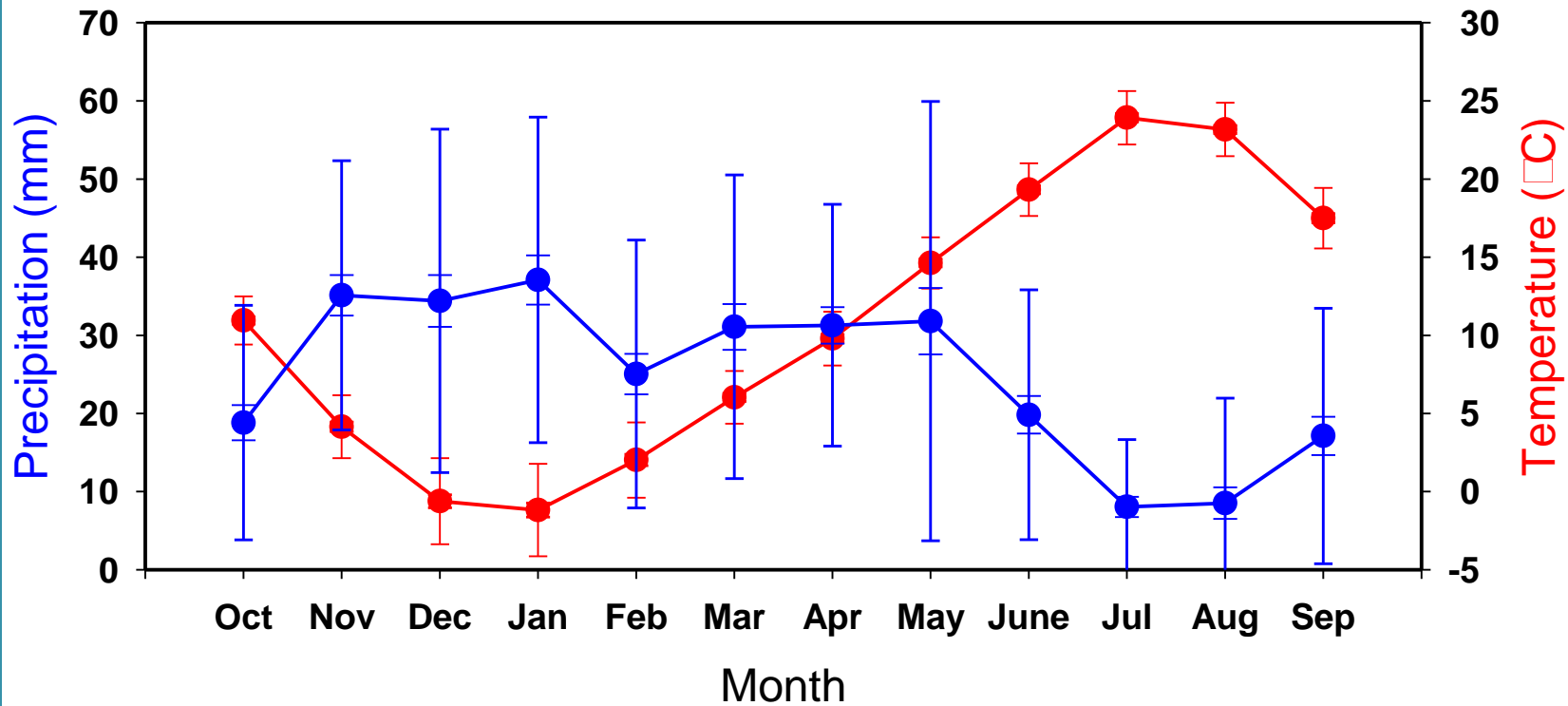
Adult



Juvenile



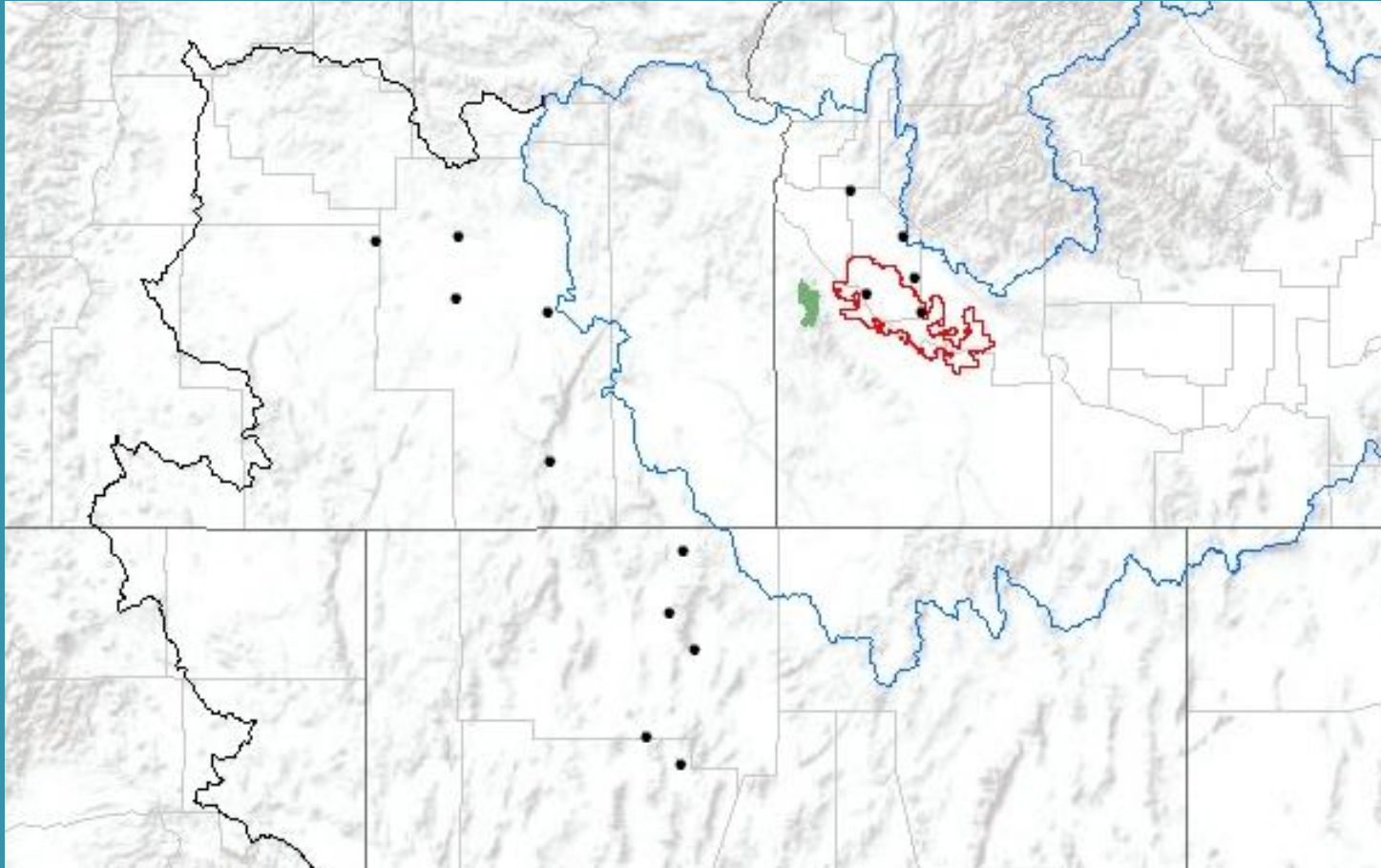
Established seedling



↔
Seeding

↔
Establishment

↔
Survival





Seed

→
↑
Rapid



Germinated seed



Emerged seedling



Adult

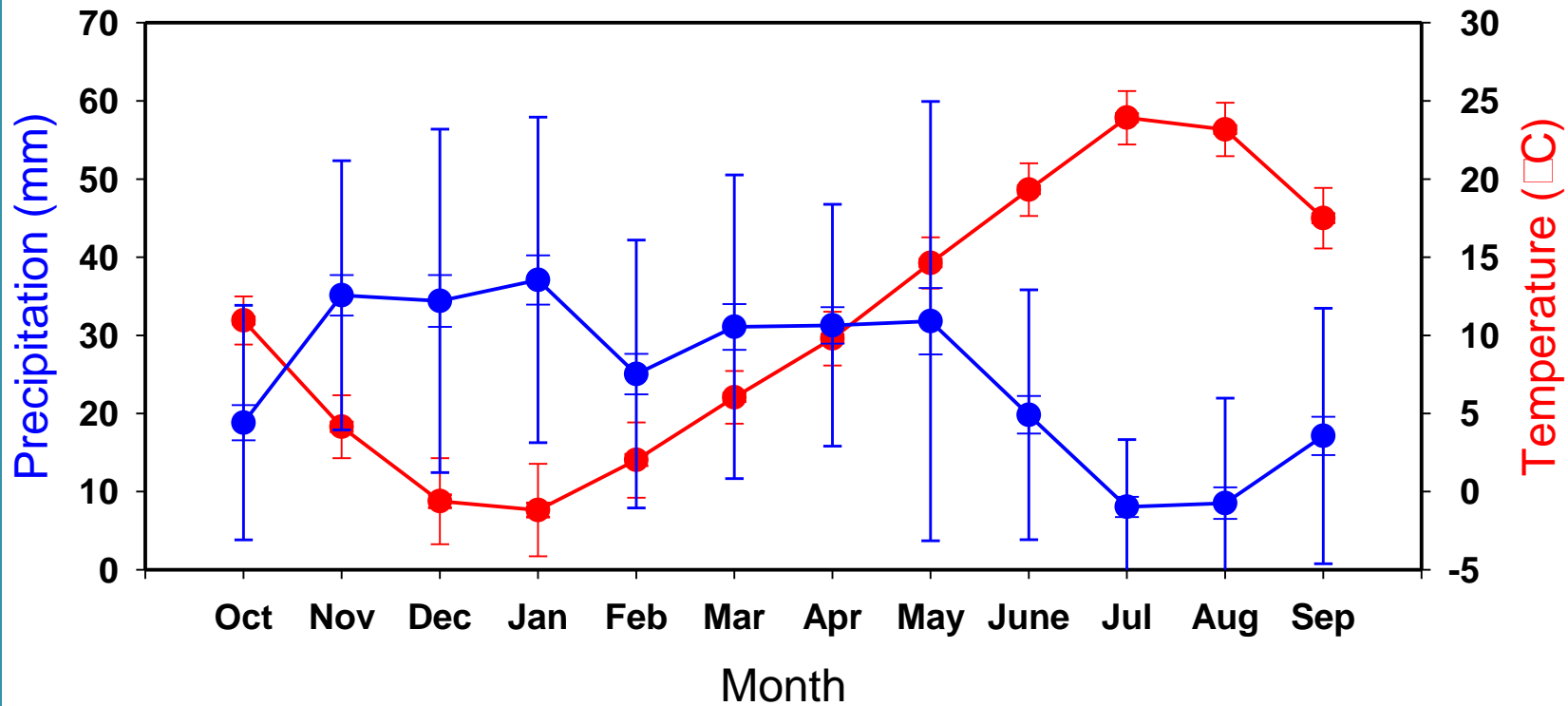


Juvenile



Established seedling





↑
Good
Fall
Weather

↑
Bad
Seedling
Emergence

Seedbed microclimatic modelling



Hydrothermal germination response modelling



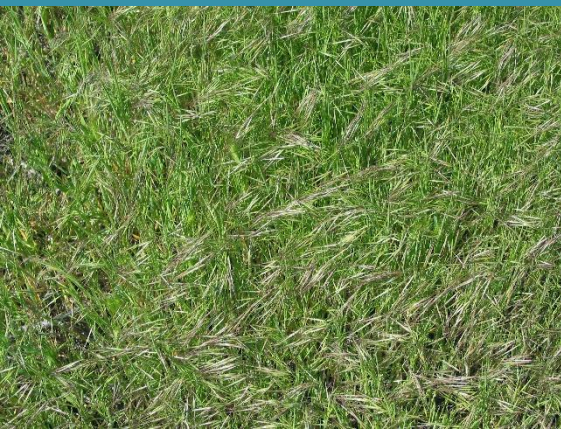
What would have happened if we planted any day in the last 44 years?

- 5 planting dates, Oct 1 – Nov 26
- Cumulative germination (whole seed population)
- Potential distribution of post-germination freezing/drought

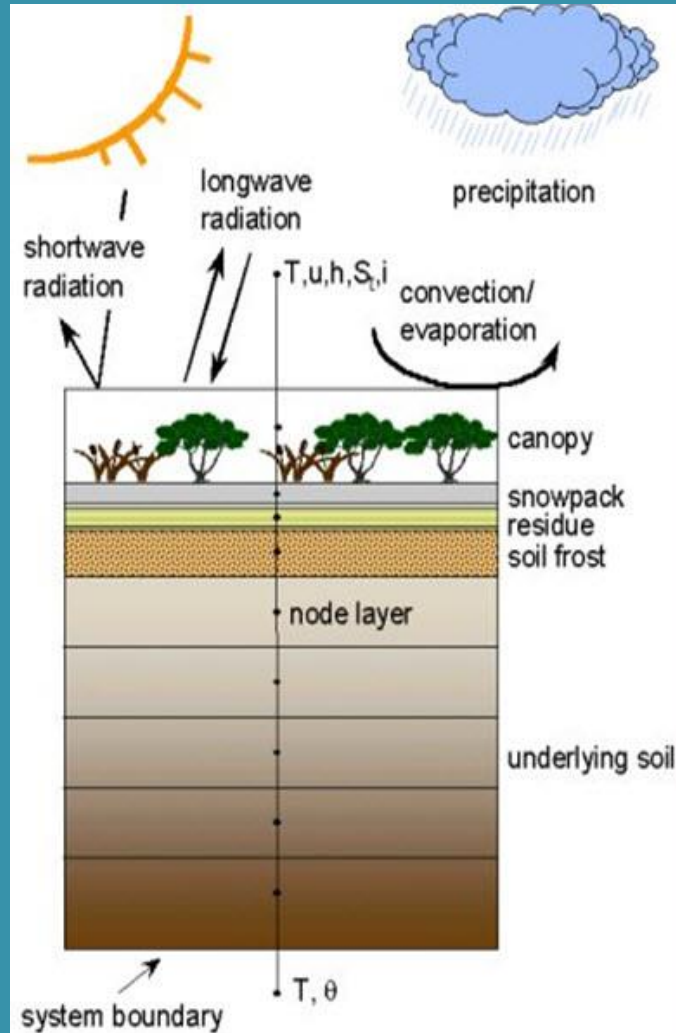


13 seedlots

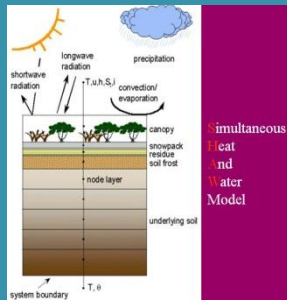
- Cheatgrass (*Bromus tectorum*)
- Bluebunch Wheatgrass (*Pseudoroegneria spicata*)
- Bottlebrush Squirreltail (*Elymus elymoides*)
- Big Squirreltail (*Elymus multisetus*)
- Thickspike Wheatgrass (*Elymus lanceolatus*)
- Sandberg Bluegrass (*Poa secunda*)
- Idaho Fescue (*Festuca idahoensis*)



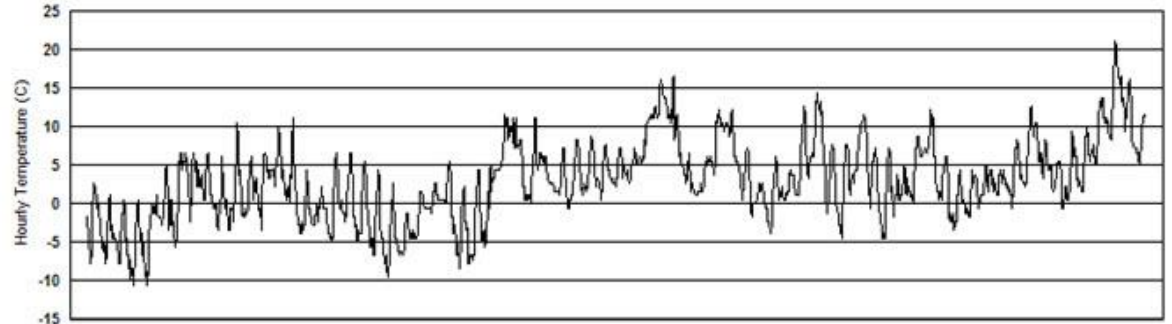




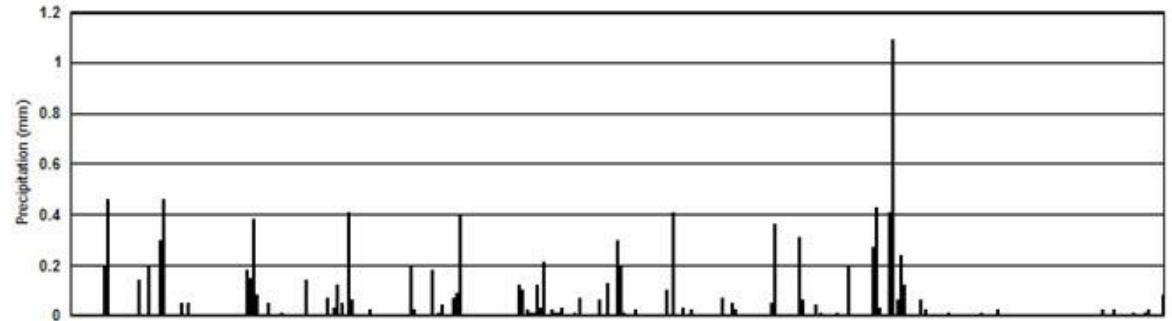
Simultaneous Heat And Water Model



simultaneous
 cat
 and
 water
 Model

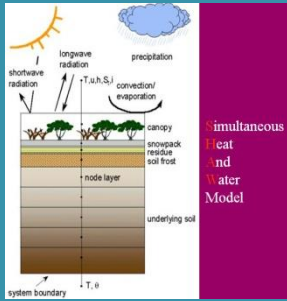


44 years of hourly temperature and precipitation

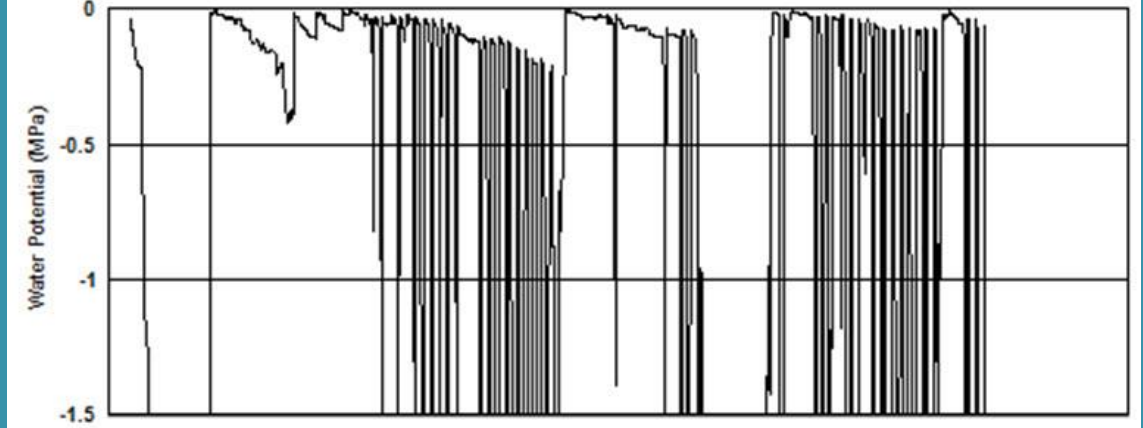
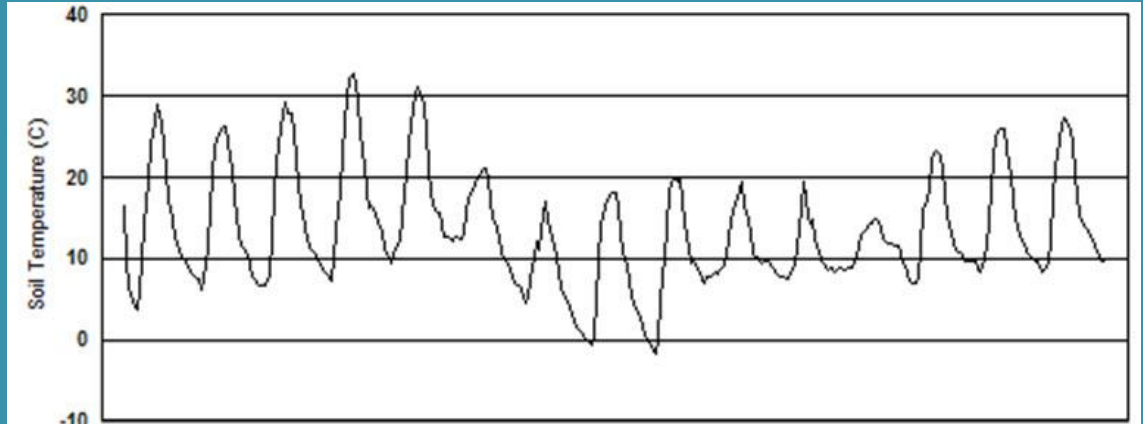
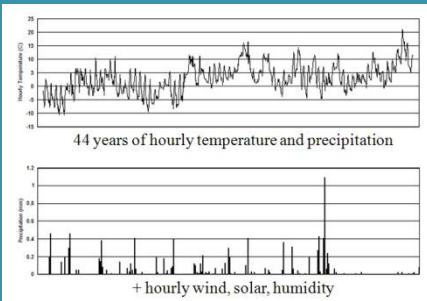


+ hourly wind, solar, humidity

Boise, Idaho



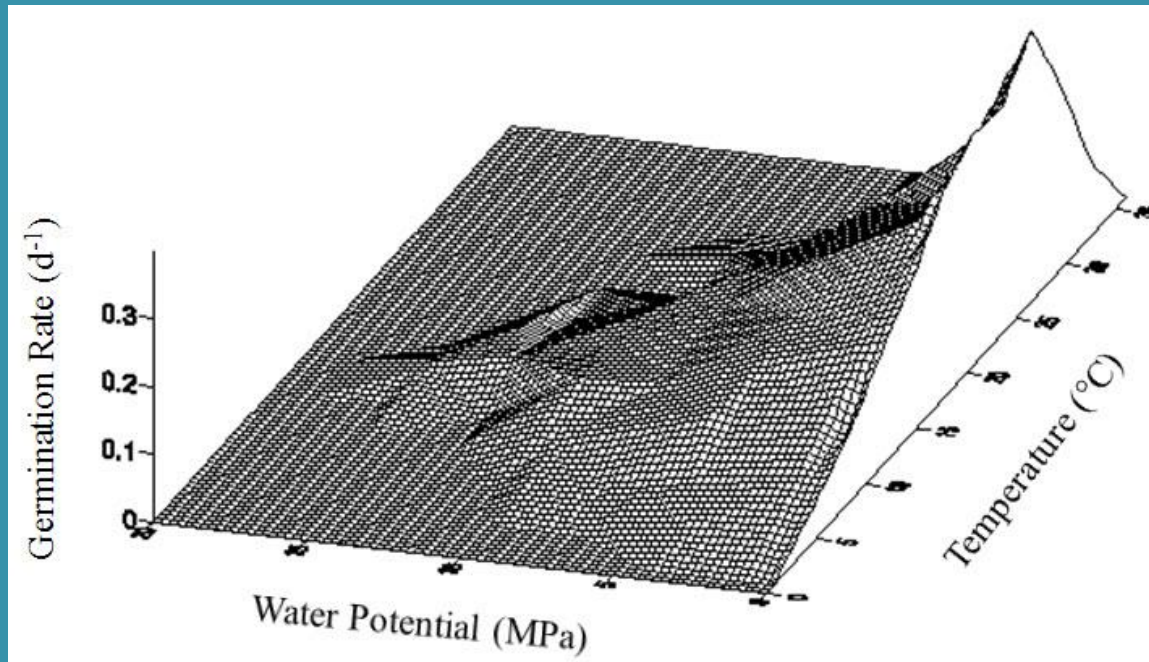
simultaneous
heat and
water
Model



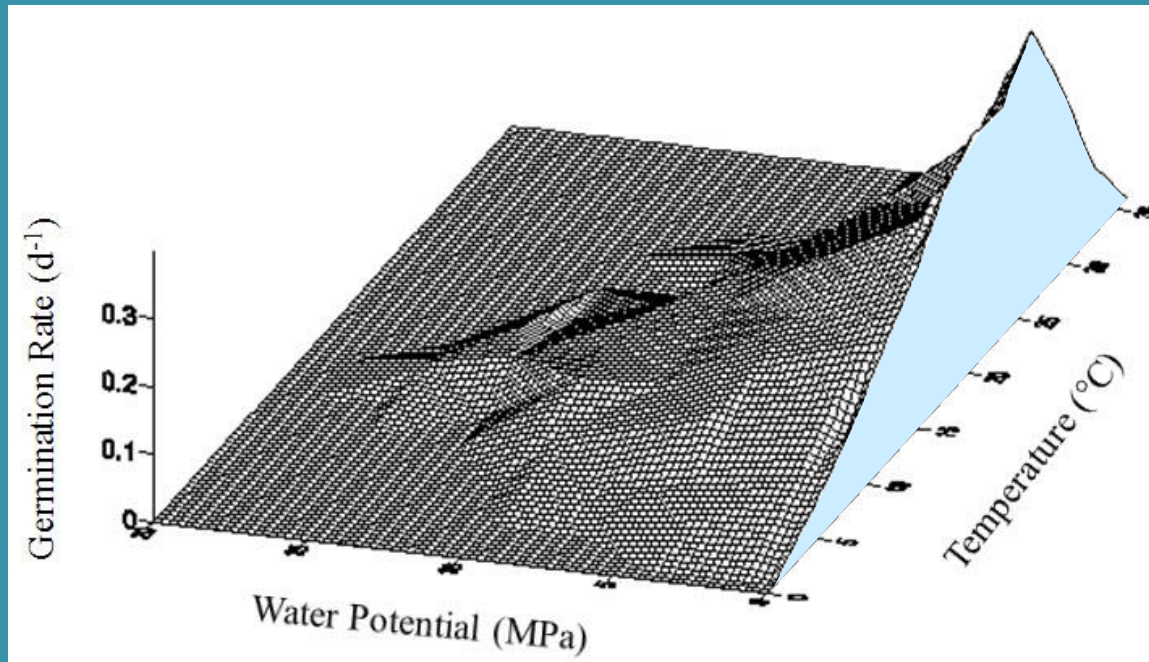
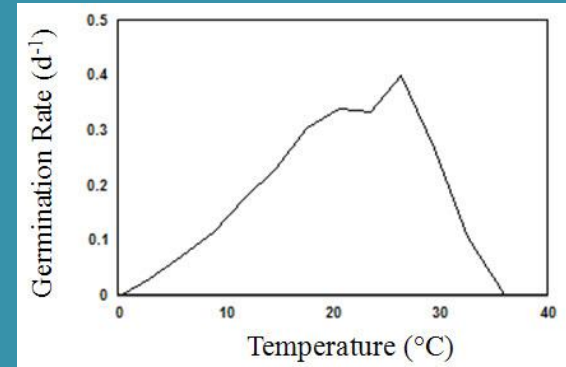
Hydrothermal Germination Response



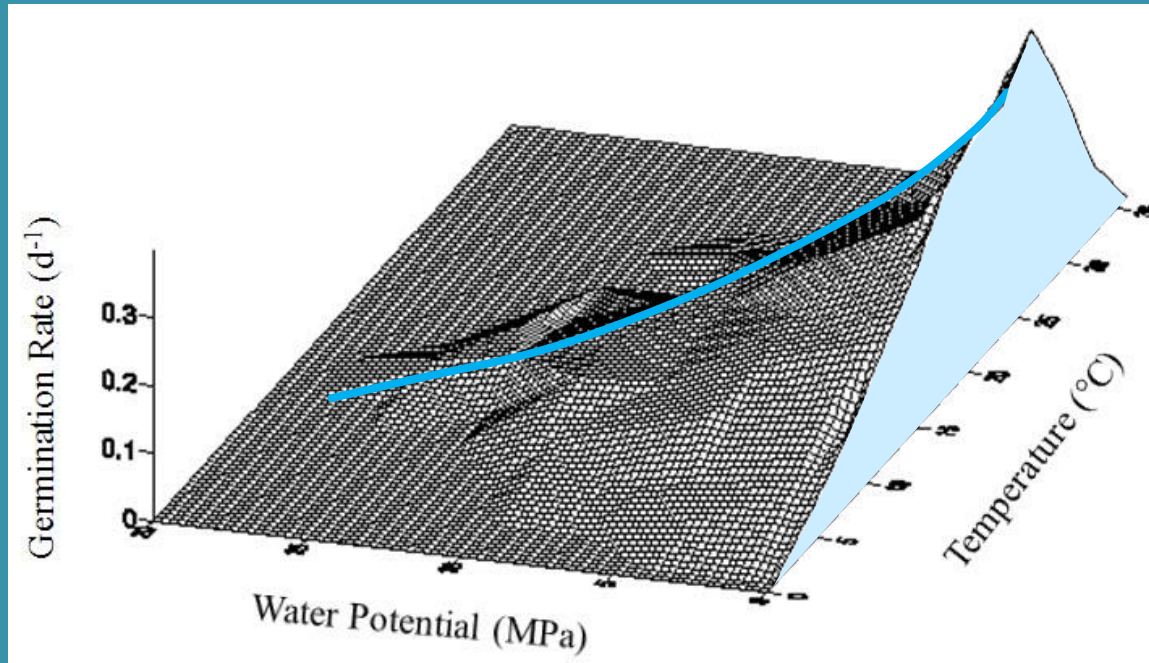
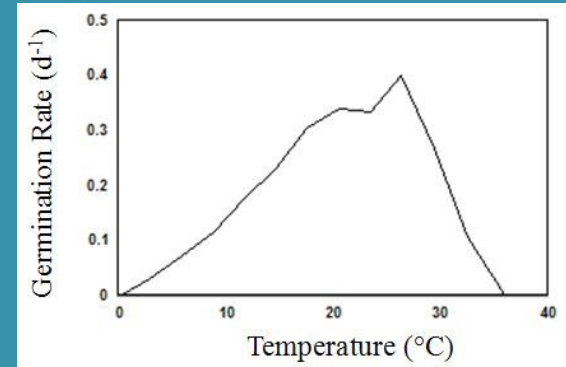
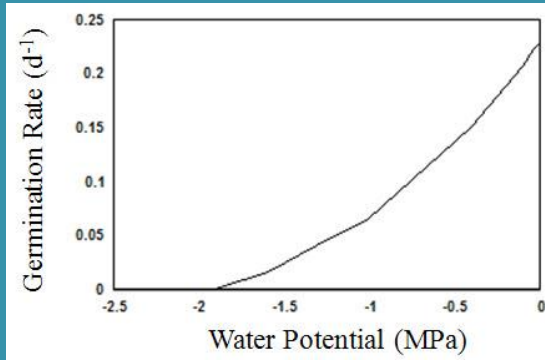
Hydrothermal Model



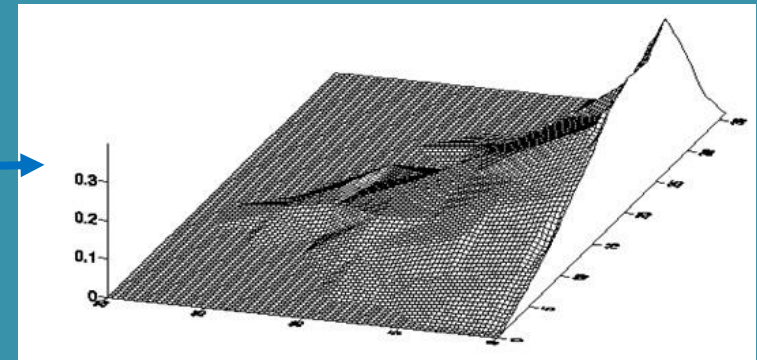
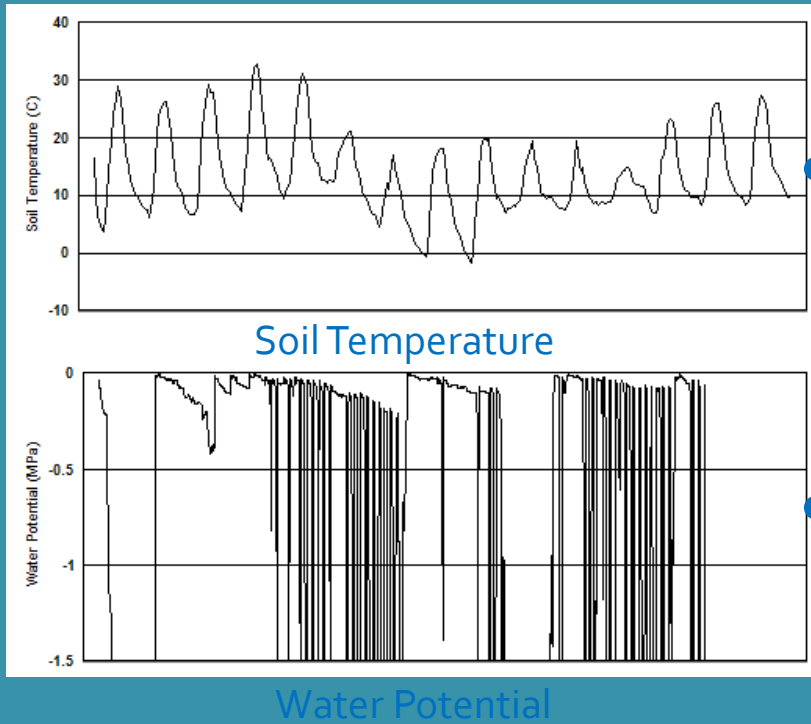
Hydrothermal Model



Hydrothermal Model



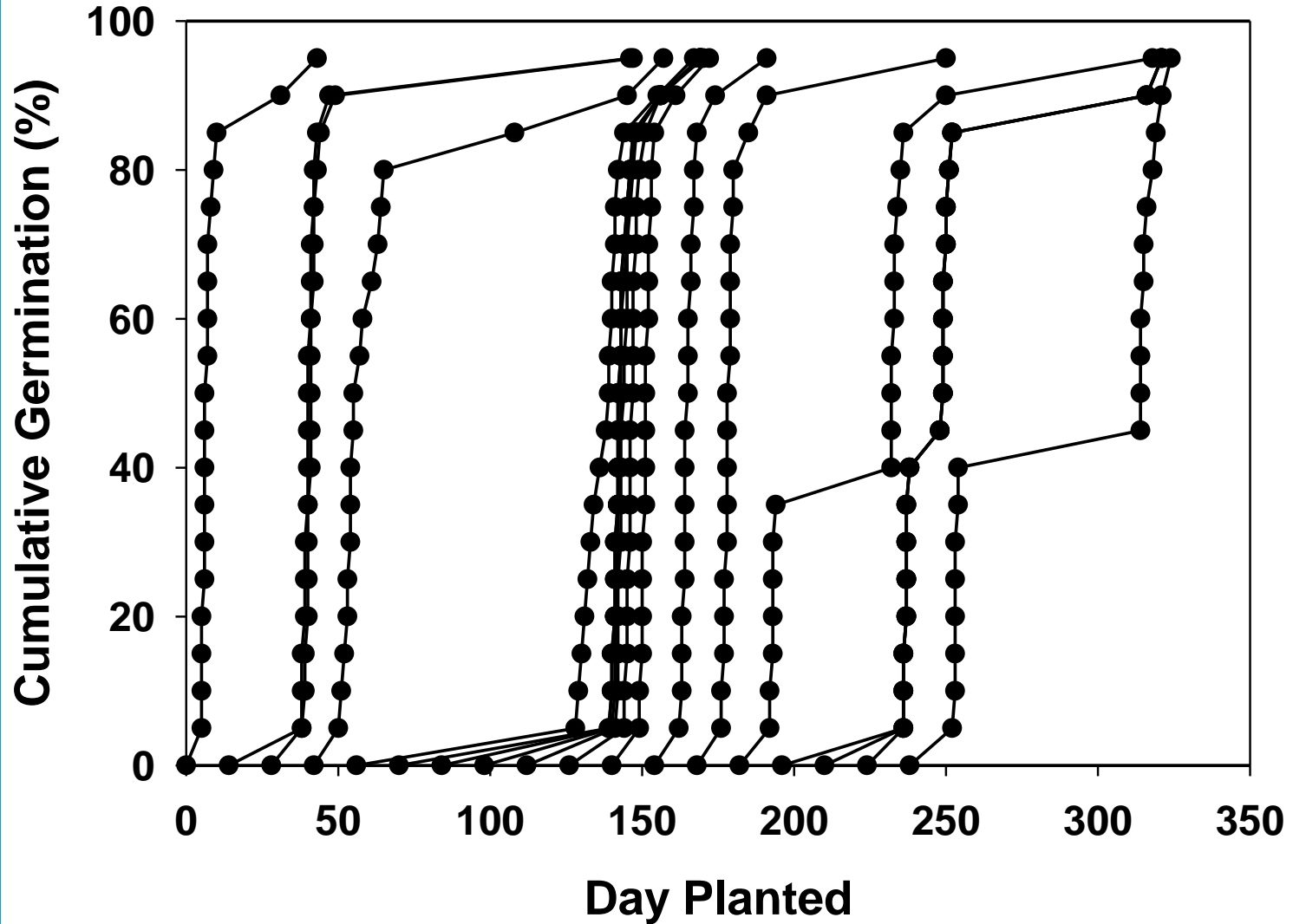
Ecological Index for Establishment/Site Favorability



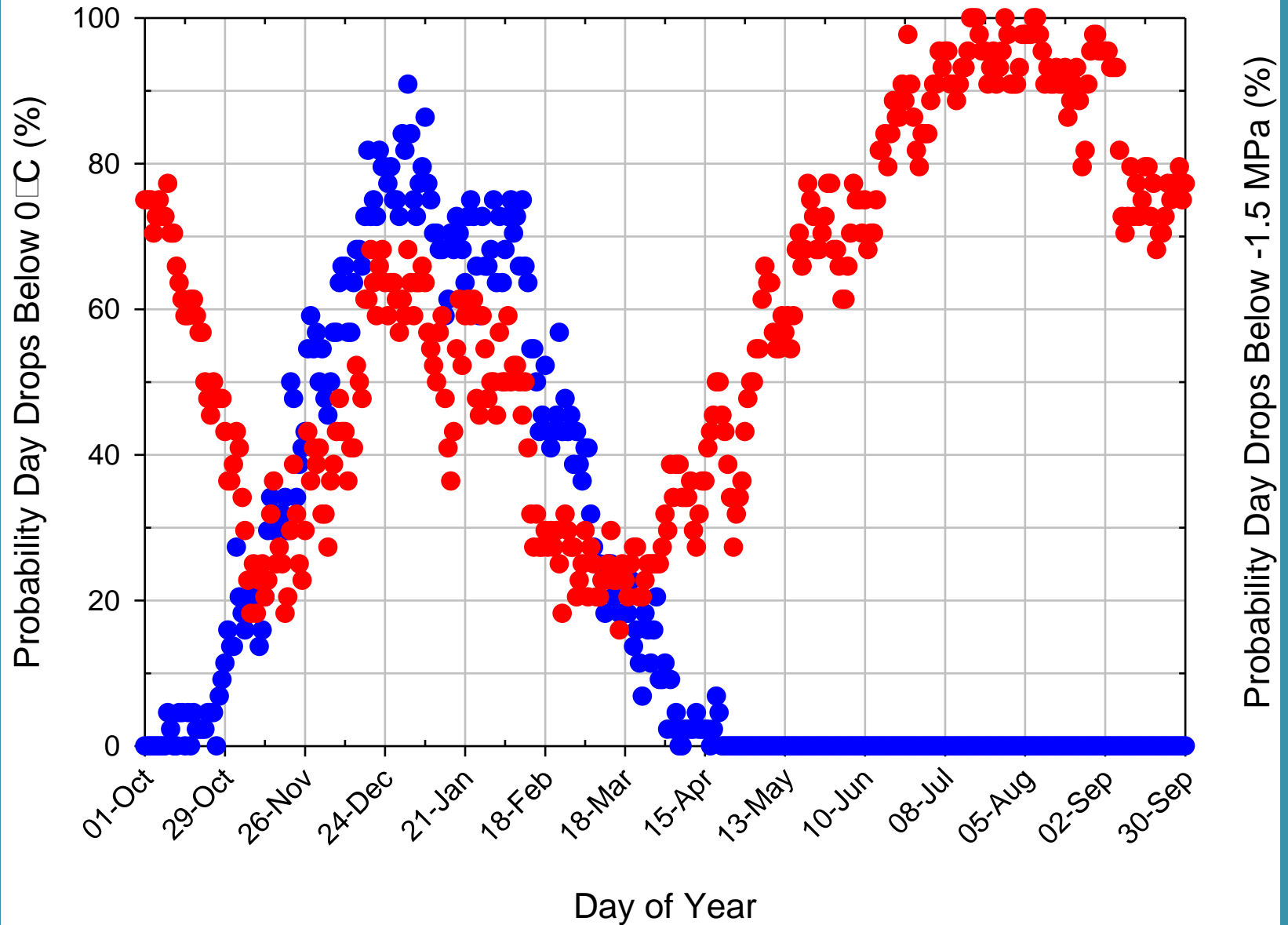
Hydro-Thermal Model

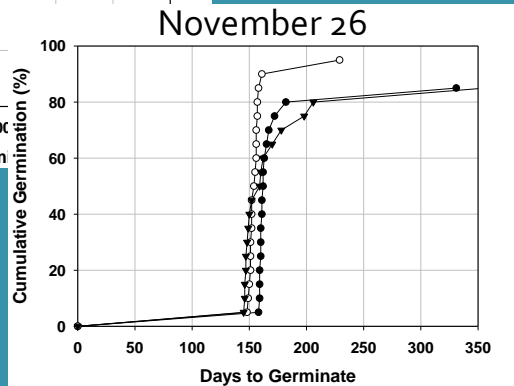
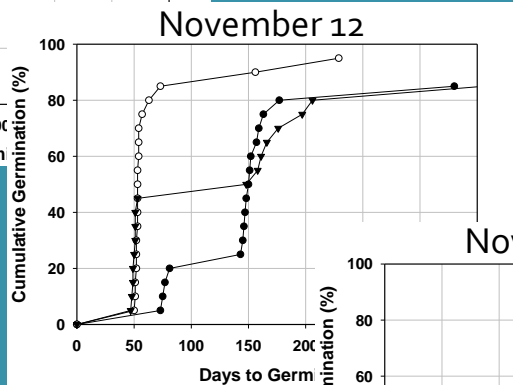
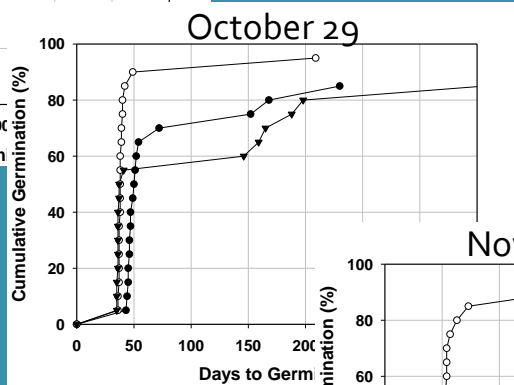
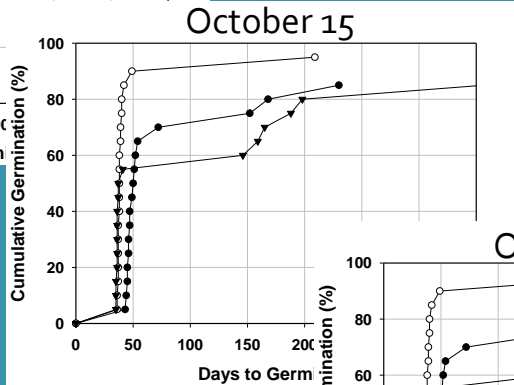
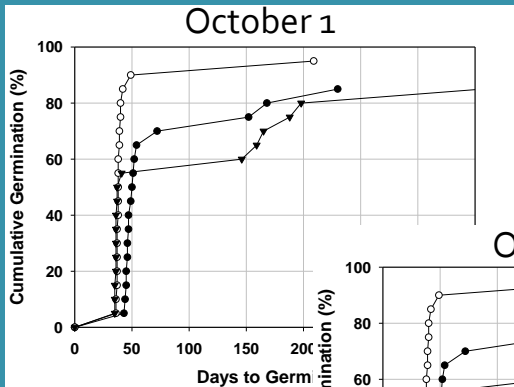
- $R = 1$ and germination occurs
- $R(\text{year, season}) = \text{\#times expected to germinate}$
- $R(\text{year, season}) = \text{relative favorability of microclimate}$
- $R(\text{year, season}) = \text{Ranking mechanism to compare years, species, treatment scenarios, forecast scenarios, etc.}$

Pulses of favorability for germination



Probability distribution of post-germination mortality





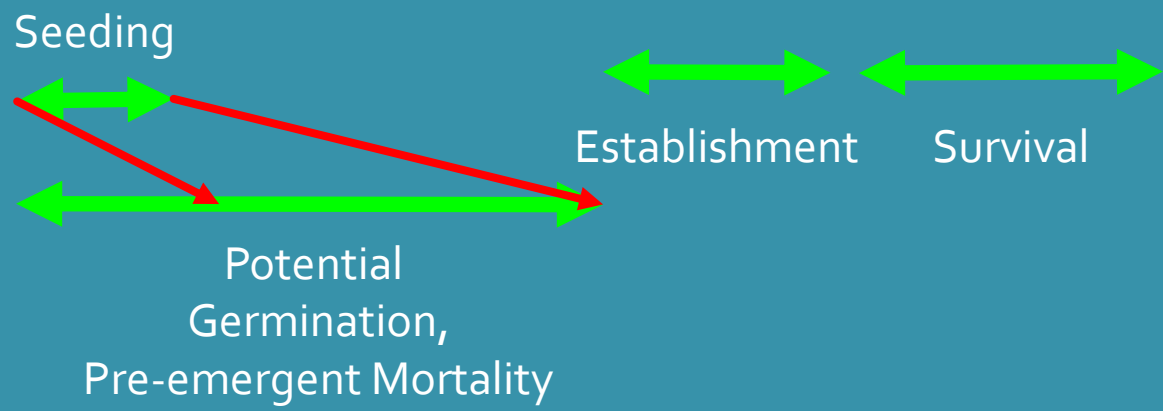
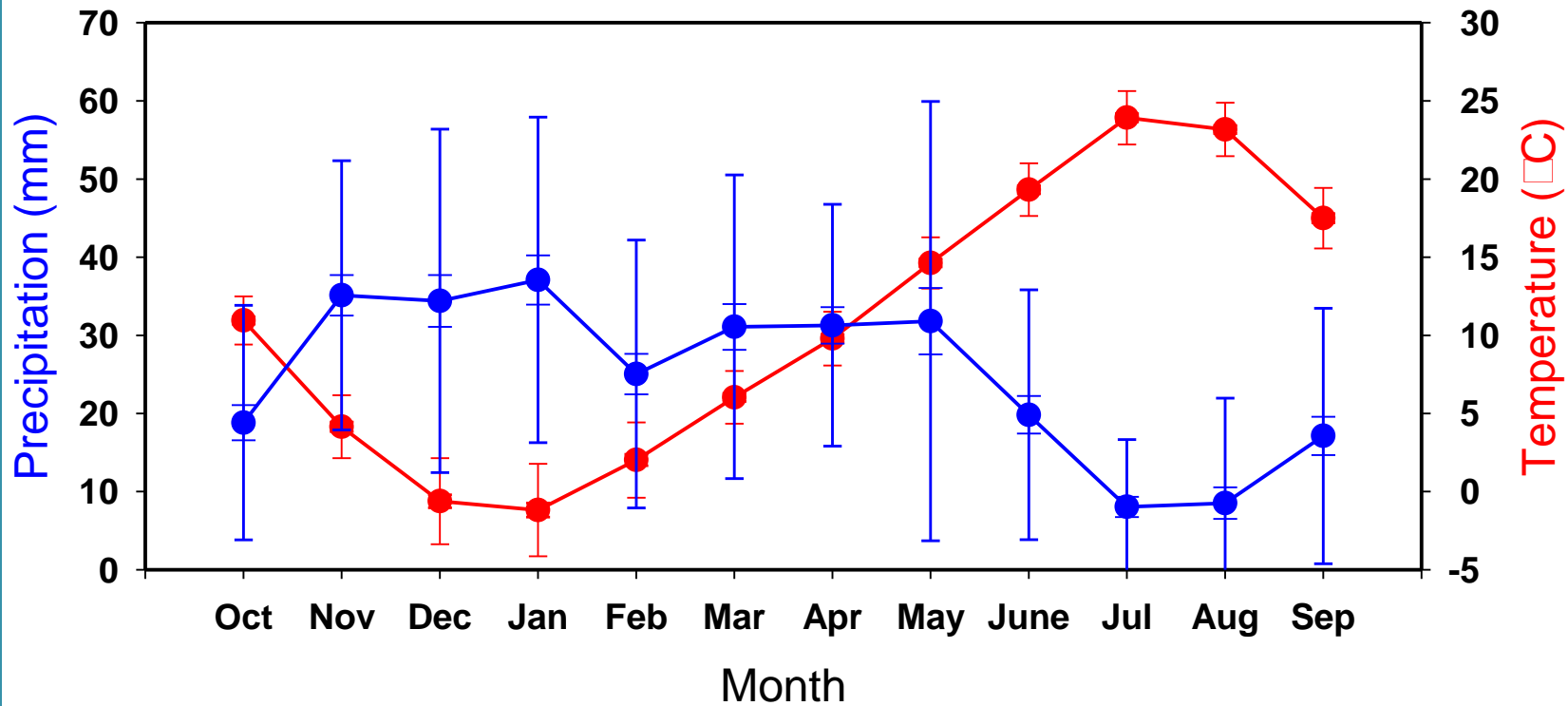
All germinate in fall

FEID avoidance



All avoidance





Cheatgrass vs native seed “germination” = apples and oranges

- Present from previous spring vs seeded
- 1,000-20,000/m² vs 250-500/m²
- Stress => set seed



Conclusions

- Post-germination/pre-emergent mortality bottleneck
- Germination a lot faster than you think. Fall germination probable if you plant early.
- Cheatgrass rate advantage not always relevant; cheatgrass seed numbers always relevant
- Large effect of planting date even within 8 week fall interval
- Late fall planting can see germination-rate syndrome effects
- Management options:
 - Plant late in fall season
 - Plant in winter/spring (not feasible)
 - Plant often (not feasible)
 - Artificial induction of rate variability

Questions?



John Abatzoglou
Alex Boehm
Cynthia Brown
Mark Brunson
Jeanne Chambers
Matt Germino
Nancy Glenn
Anne Halford
Katherine Hegewisch
Jeremy James
Gwendwr Meredith

Corey Moffet
Tom Monaco
Génie MontBlanc
Mike Pellant
David Pilliod
Bruce Roundy
Nancy Shaw
Roger Sheley
Tony Svejcar
Justin Welty



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This and additional presentations available at <http://nativeseed.info>

