# GENETIC AND CYTOTYPIC VARIABILITY IN A DOMINANT SOUTHWESTERN GRASS (*BOUTELOUA GRACILIS*)

## Implications for Restoration and Seed Source Conservation

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USGS science for a changing world

Photo by James R. Page

# LOCAL ADAPTATION

- Local adaptation:
  - Is likely to influence the response of a species to climate change
  - May be predictive of the success of cultivated seeds for restoration purposes

# RESTORATION IN THE SOUTHWEST

- Primarily driven by wildfire
- 7.2 million AC annually in US (3X AC burned in 1980s)
- Forest Service alone spends $3.3 million/year on seeding

Peppin et al., 2010
National Interagency Fire Center

# CULTIVARS AND NATURAL POPULATIONS

- Locally adapted seed recognized for increased restoration success
- Cultivated varieties and selection pressure of agriculture:
  - Selection for large biomass, high seed yield
  - Potential loss of traits that allow for survival in a variable wildland climate


Schroder & Prasse, 2013

# OBJECTIVES

1) Genetic structure of *Bouteloua gracilis* on the Colorado Plateau

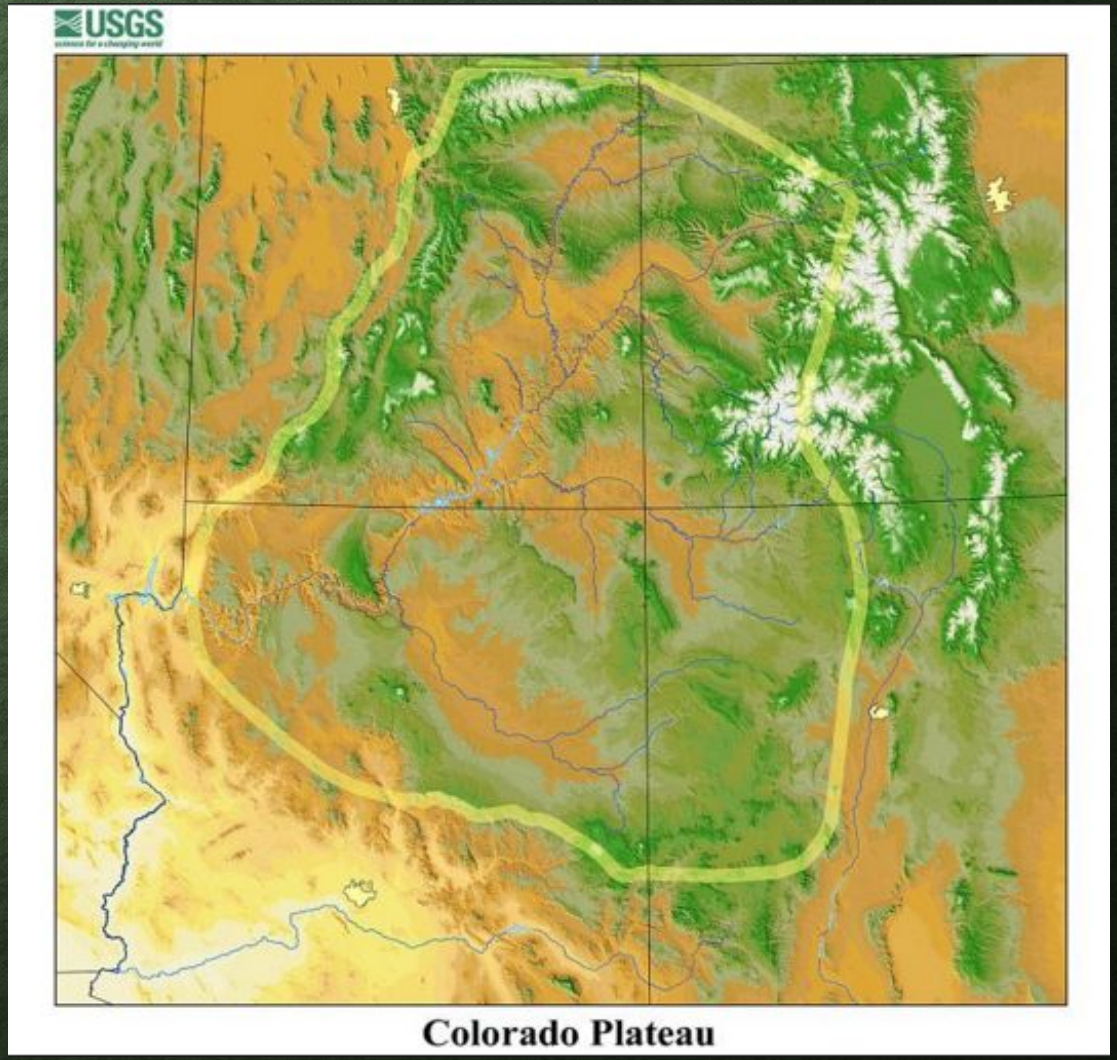
2) Correlation with key environmental variables

3) Genetic differentiation of wild populations and cultivars



# STUDY SITE: THE COLORADO PLATEAU

- 140,000 sq. miles in the 4- corners region
- Sonoran Desert to Alpine, 3,000-14,000 ft
- Dominated by semiarid conditions with broad distribution of annual precip
  - Average of 10”
  - Low elevations as little as 5”
  - >8,000 ft., 20”; >11,000 ft, 36”
- Variable temperatures
  - Lower elevations: 20-90 F
  - Higher elevations: 0-70 F



Colorado Plateau

Foos, 1999

# STUDY SPECIES: *BOUTELOUA GRACILIS*

- Broadly distributed perennial grass
- Variable habitat types from semi-desert grass
- High valued species n and r bilitation
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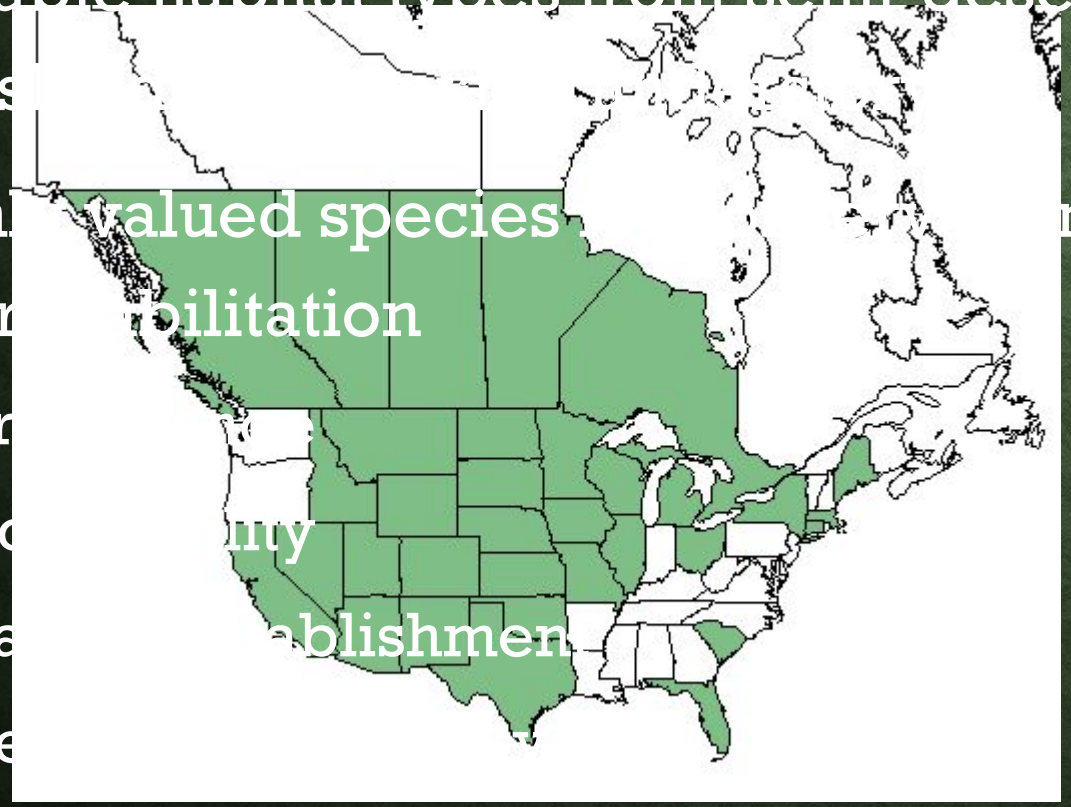
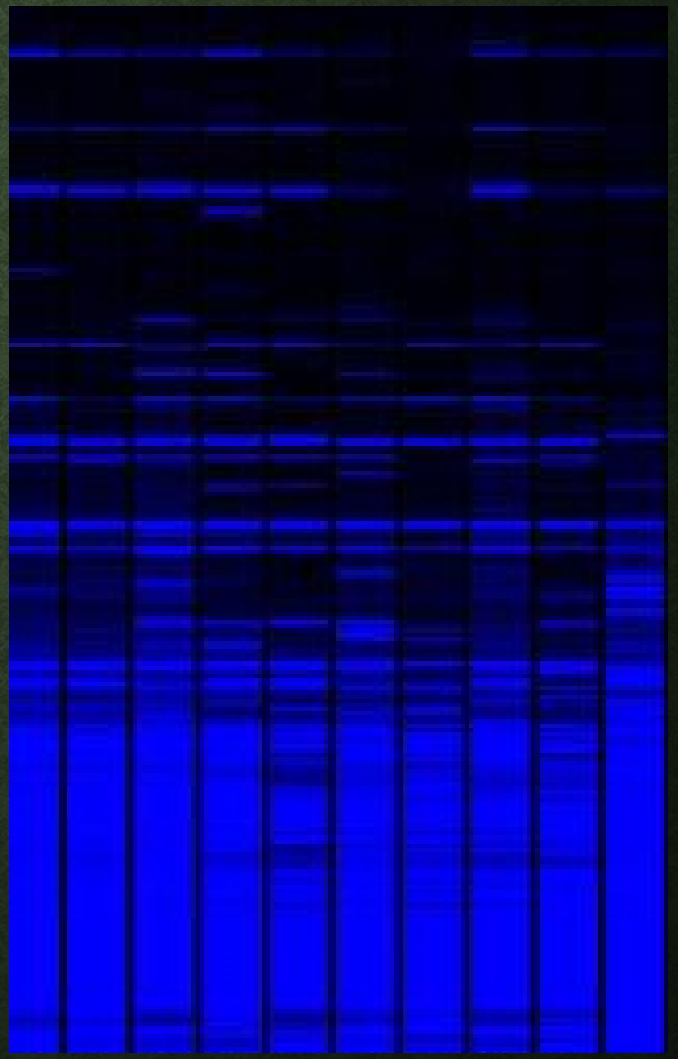


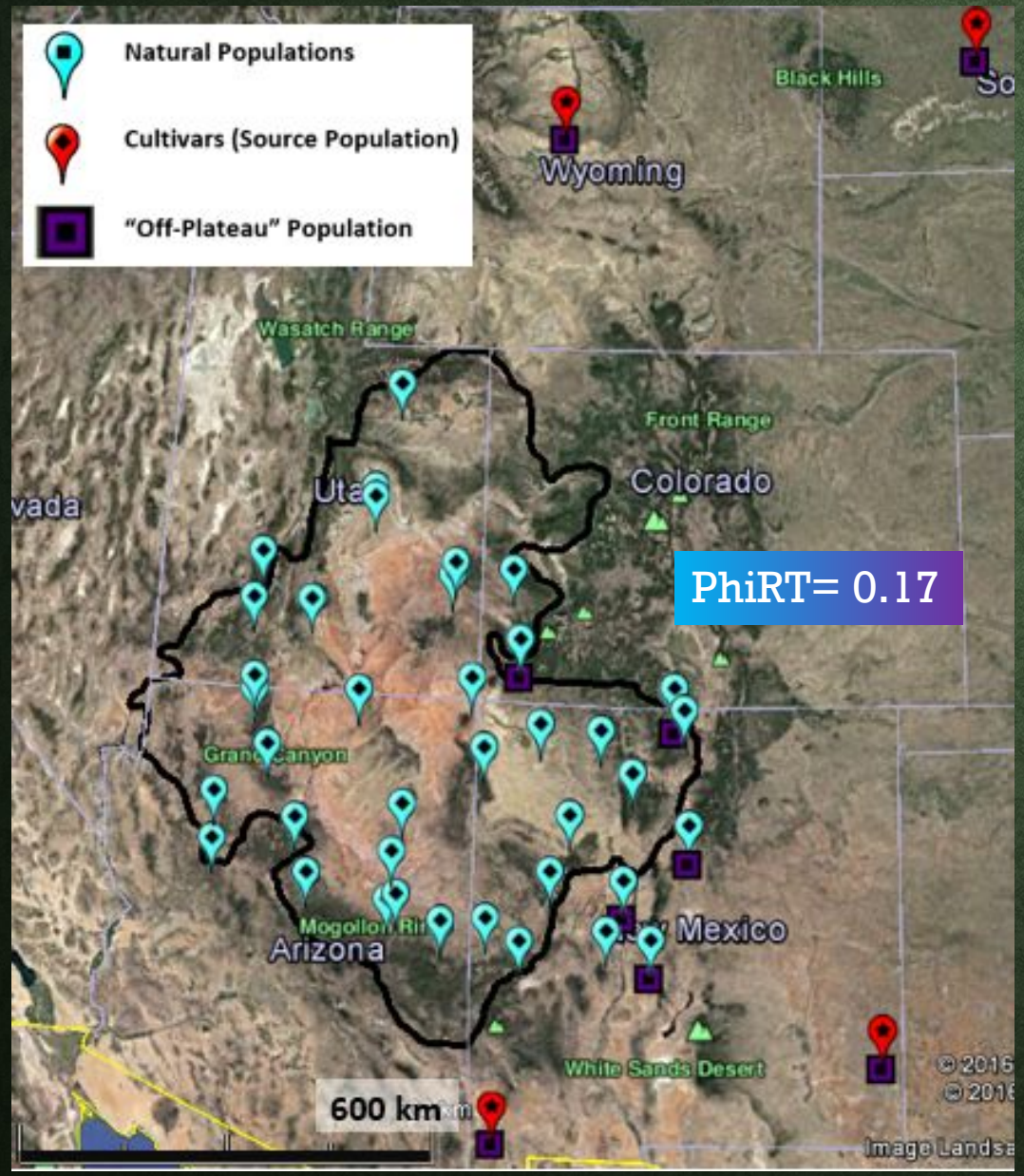
A. Hitchcock

# GENETIC FINGERPRINTING ANALYSIS

- Amplified fragment length polymorphism (AFLP)
  - Rapid screening technique
  - Generates anonymous markers throughout the genome
- Sampling
  - 385 individuals
  - 44 natural sites, 5 cultivars
  - 3 primer combinations
- 100 markers scored
  - 6 identified as likely under selection



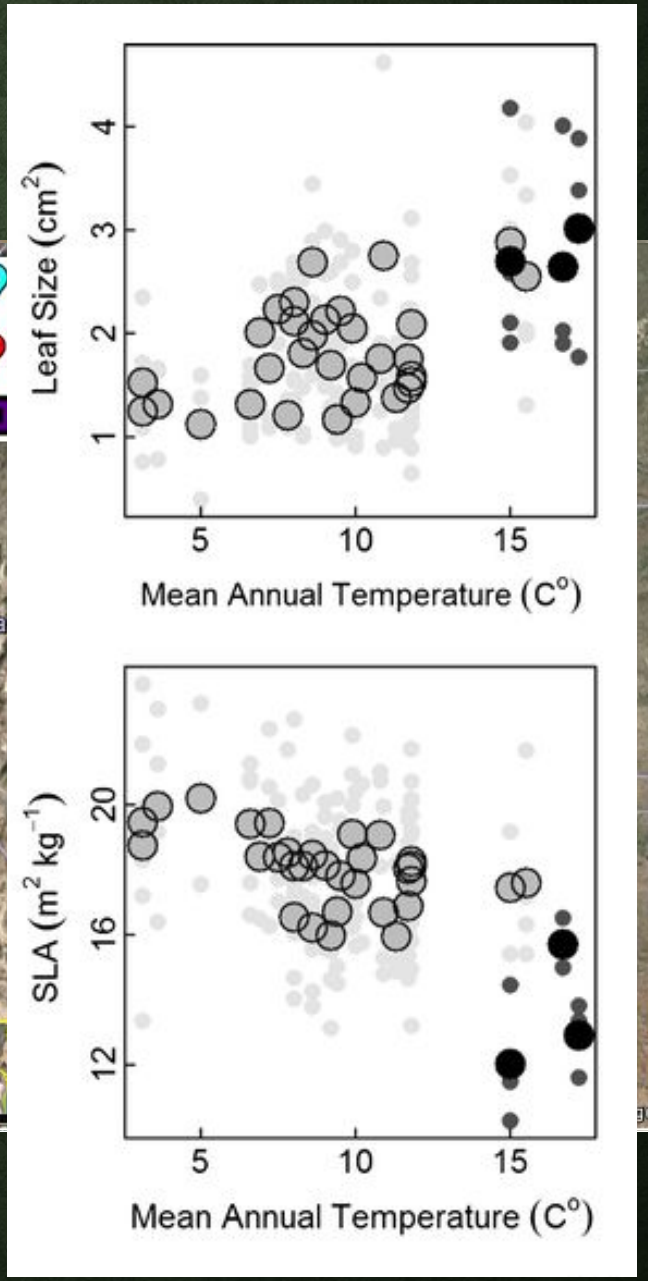
# Genetic Structure (AFLP)




# ENVIRONMENTAL ANALYSIS

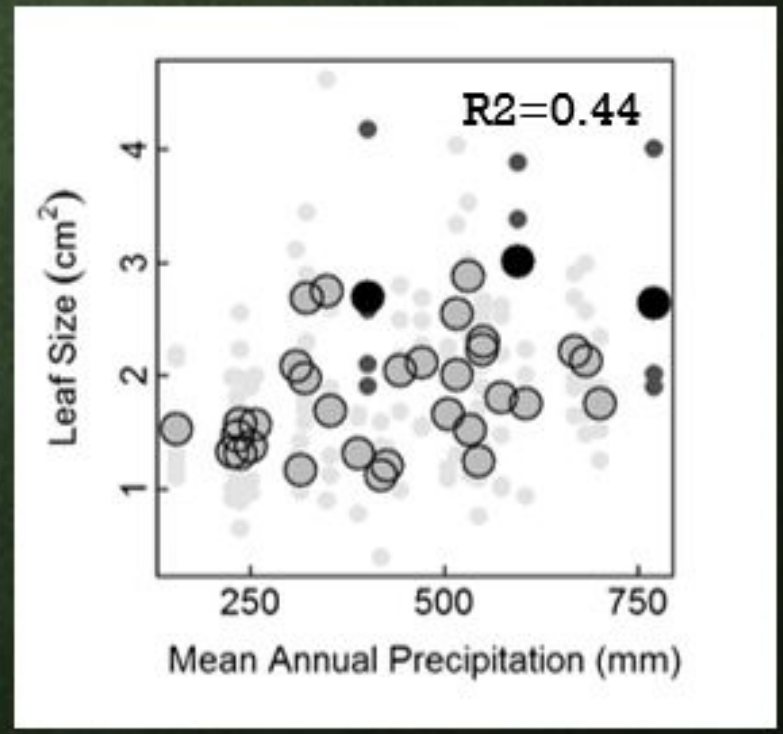
- Temperature
  - Mean Annual Temperature
  - Temperature Seasonality
- Precipitation
  - Mean Annual Precipitation
  - Precipitation Seasonality
  - Precipitation Coldest Quarter
  - Precipitation Driest Quarter

# MEAN ANNUAL TEMPERATURE



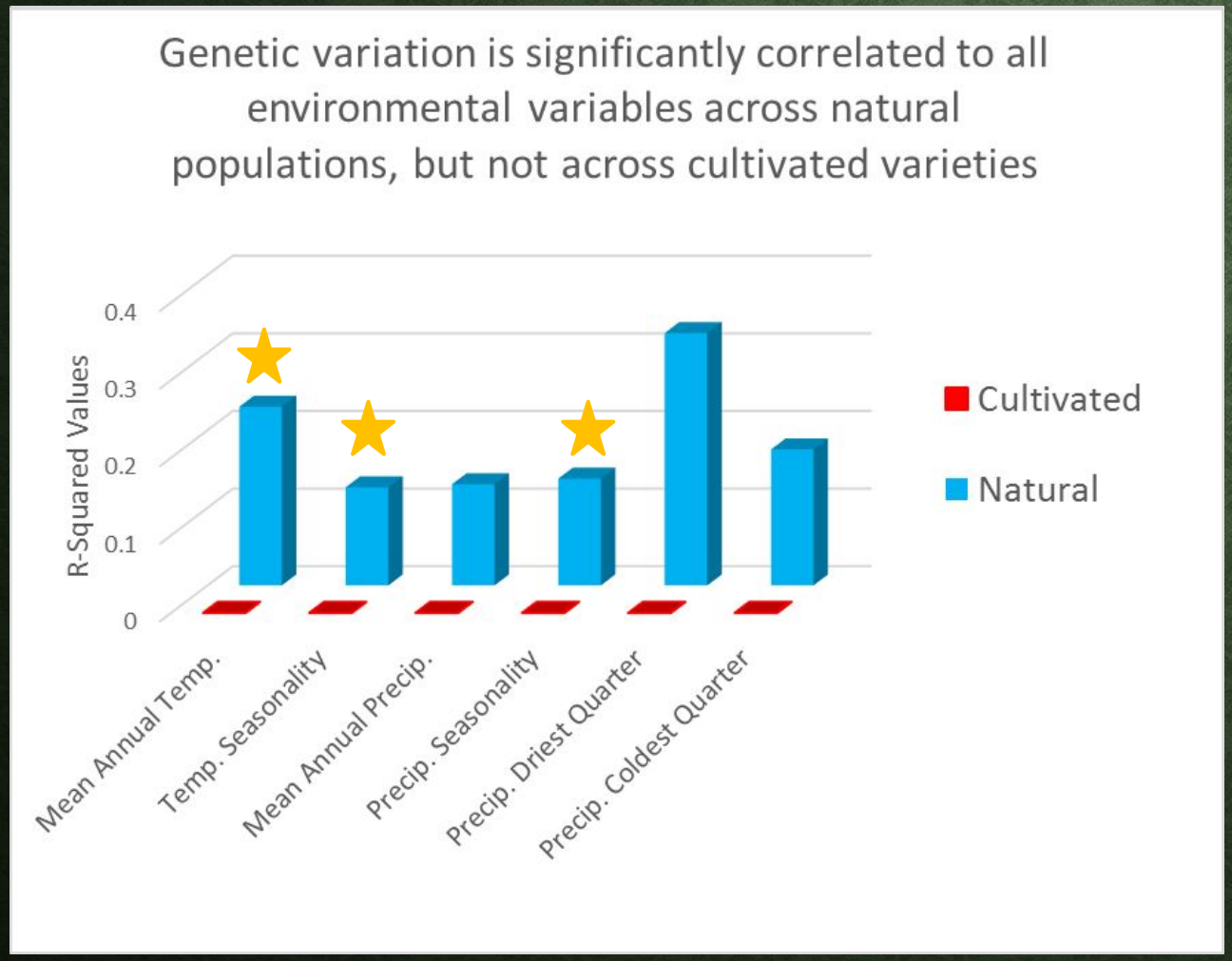

Butterfield and Wood, 2015

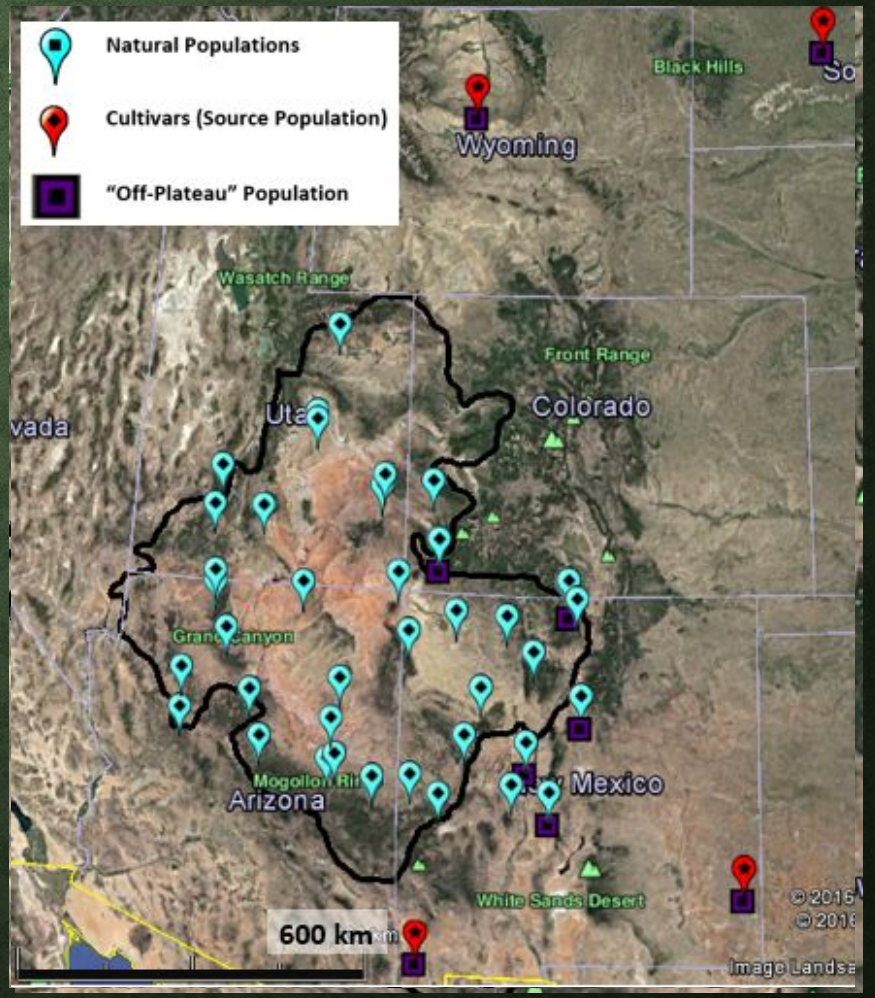
# MEAN ANNUAL PRECIPITATION


Butterfield and Wood, 2015

# GENETIC RESPONSE TO CLIMATE: POPULATIONS CULTIVARS



# SUMMARY

## NATURAL POPULATIONS

- 2 genetically distinct populations:
  - Colorado Plateau
  - Off Colorado Plateau
- Genetic variation correlated to:
  - Environment
  - Population
  - Cytotype
- Colonization history; adaptive differences in cytotypes and populations

## CULTIVATED VARIETIES

- Group with only 5 of 44 natural populations
  - Off-Plateau
- Genetic variation not correlated to environment
- Suggested loss of locally adapted traits in response to agricultural environment

# FUTURE RESEARCH & MANAGEMENT RECOMMENDATIONS

- Future Research
  - cpDNA analysis, additional sampling, reciprocal transplant experiment
  - Use data to:
    - develop models to identify seed transfer zones for this species across the Colorado Plateau
    - climate change models to aid in assisted gene flow research and efforts


QUESTIONS?

The preceding presentation was delivered at the

# 2017 National Native Seed Conference

Washington, D.C.  February 13-16, 2017

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

NATIVE SEED NETWORK

Institute for Applied Ecology