

# The influence of light intensity, water availability and planting method on *Eragrostis tef* seedling emergence, growth and survival.

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# Background

- Burning, mowing and grazing are key grassland management techniques
  - Clear moribund material
  - Maintain species diversity
  - Trampling and nutrient cycling
  - Growth vigour and productivity
- Management influences
  - Plant dimensions, basal cover, species composition
  - Microsite beneath and between plants/tufts



## Recruitment and persistence of new plants via seed germination

- Shade
    - Light and temperature
  - Water availability
    - Alter soil moisture through evaporation
  - Seed burial
    - Hoof action (trampling), burying seed and soil compaction
- Contribute to sustainable grassland management

How do shade, water availability and planting method influence seedling emergence, growth and survival?



## *Eragrostis tef*

- Annual C4 grass
- Important cereal crop in Ethiopia
- High quality feed
- Germinates quickly
- Adapted to survive drought periods and water-logged soils



2



3



# Selection of shade levels and planting method

Based on germination

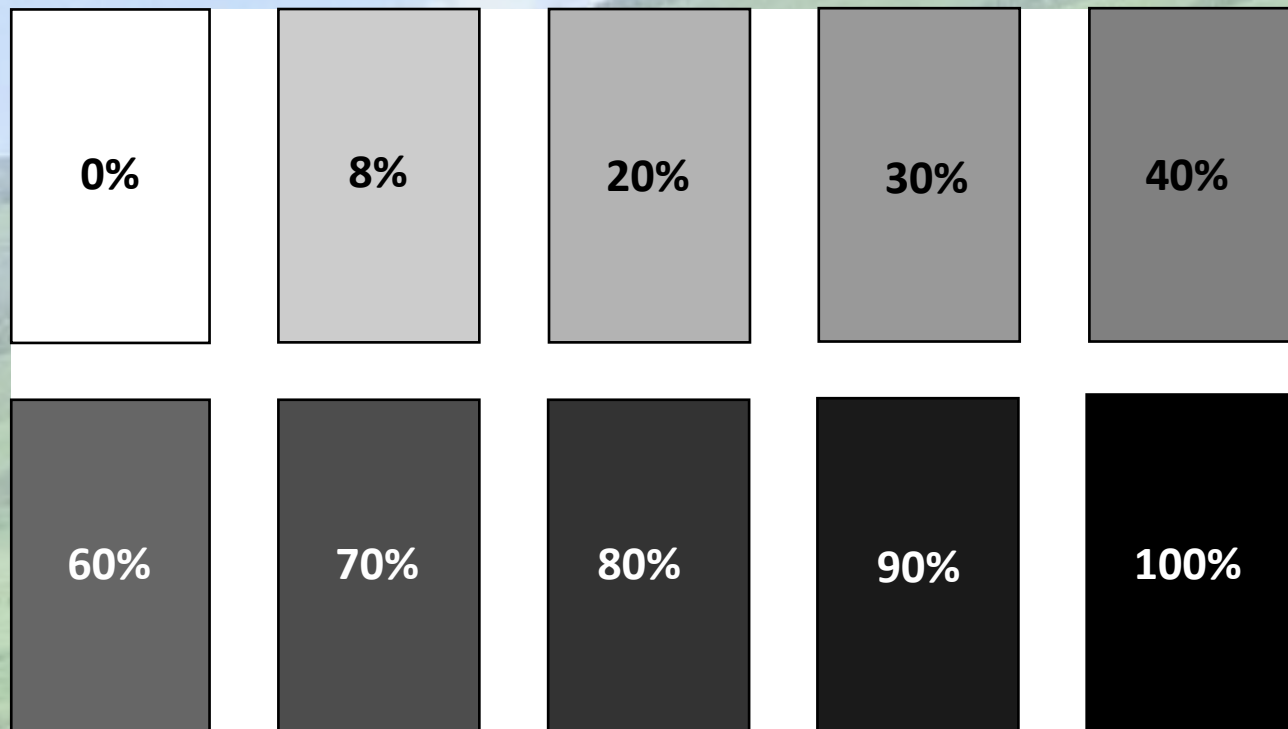
- 100 seeds per treatment (6 reps.)

☒ **Shade (0 - 100%)**

☒ **Planting method**

Buried > Surface

( $p < 0.001$ )



# Trial design

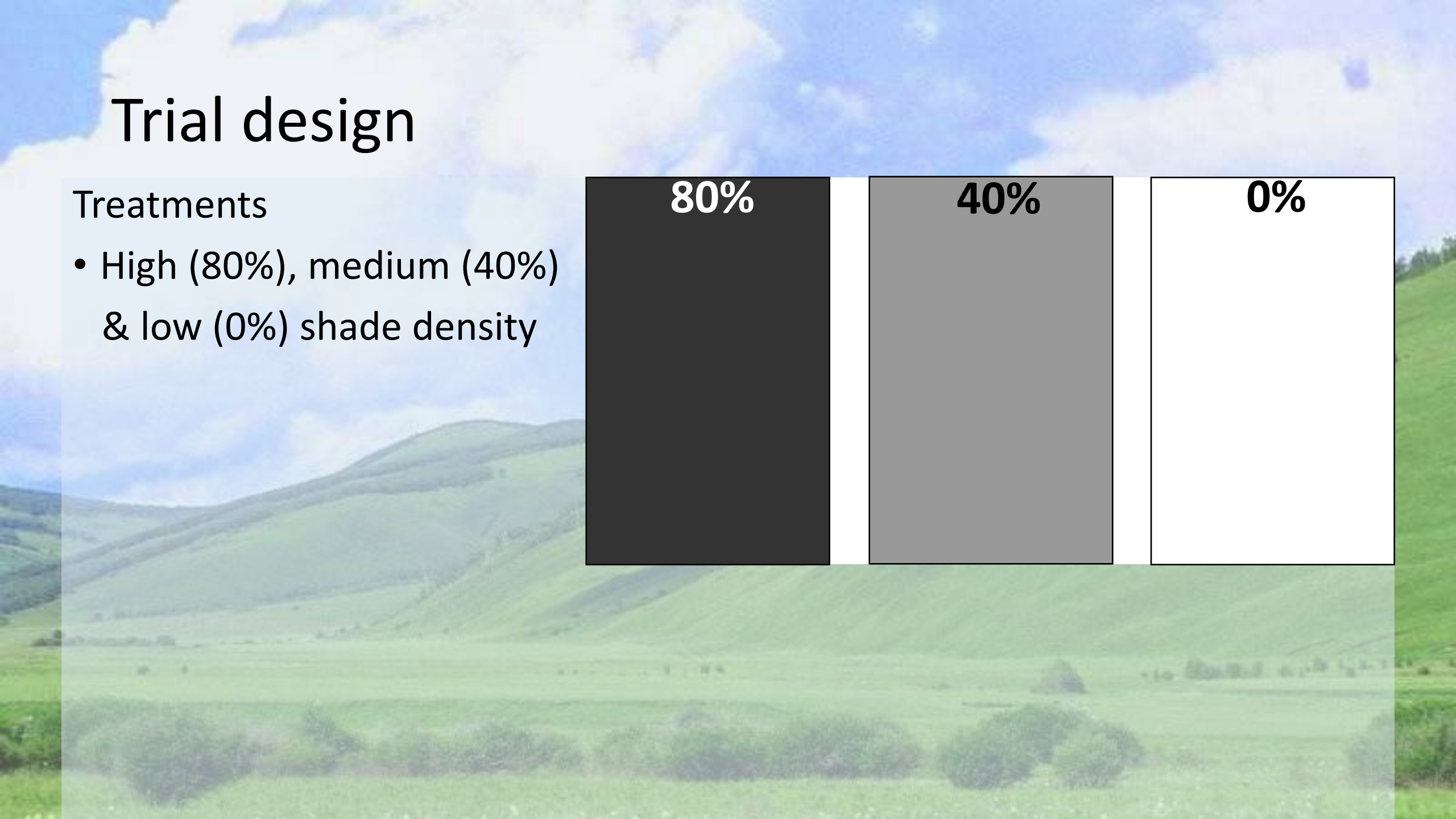
## Treatments

- High (80%), medium (40%) & low (0%) shade density

**80%**

**40%**

**0%**

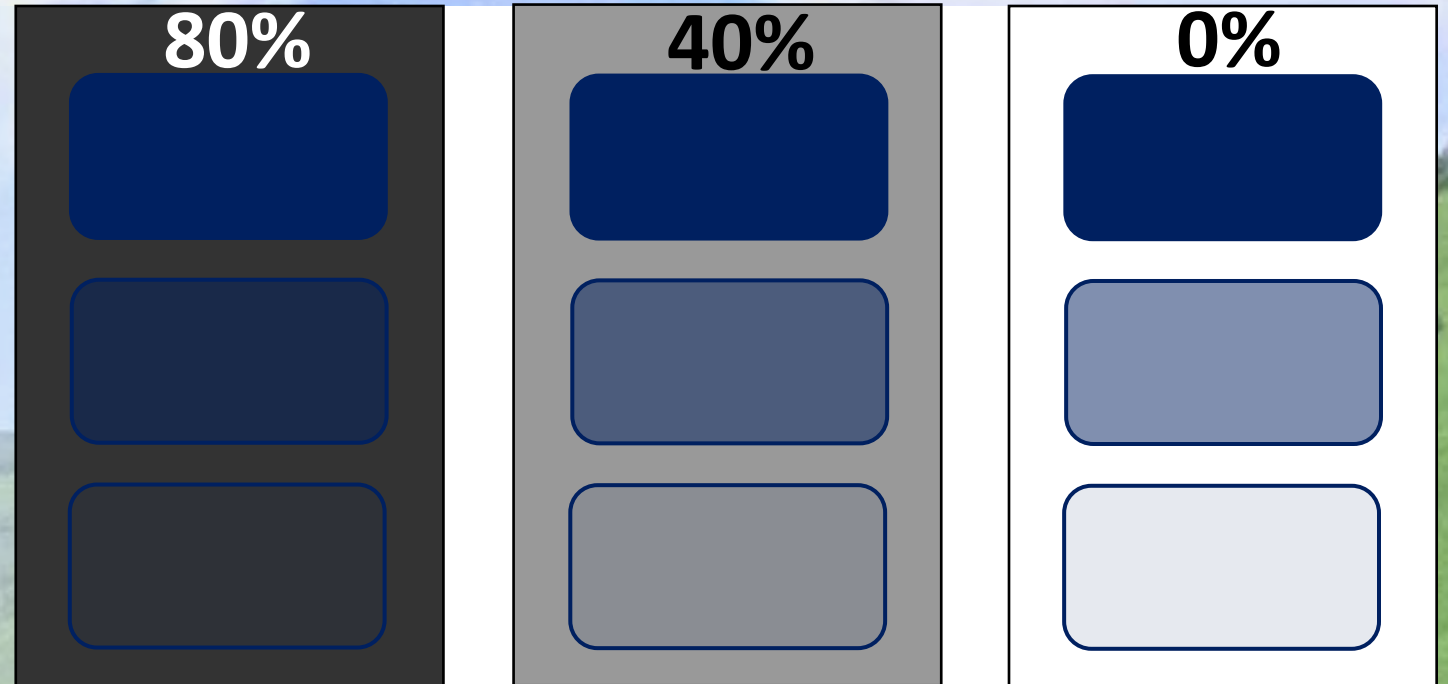




# Trial design

## Treatments

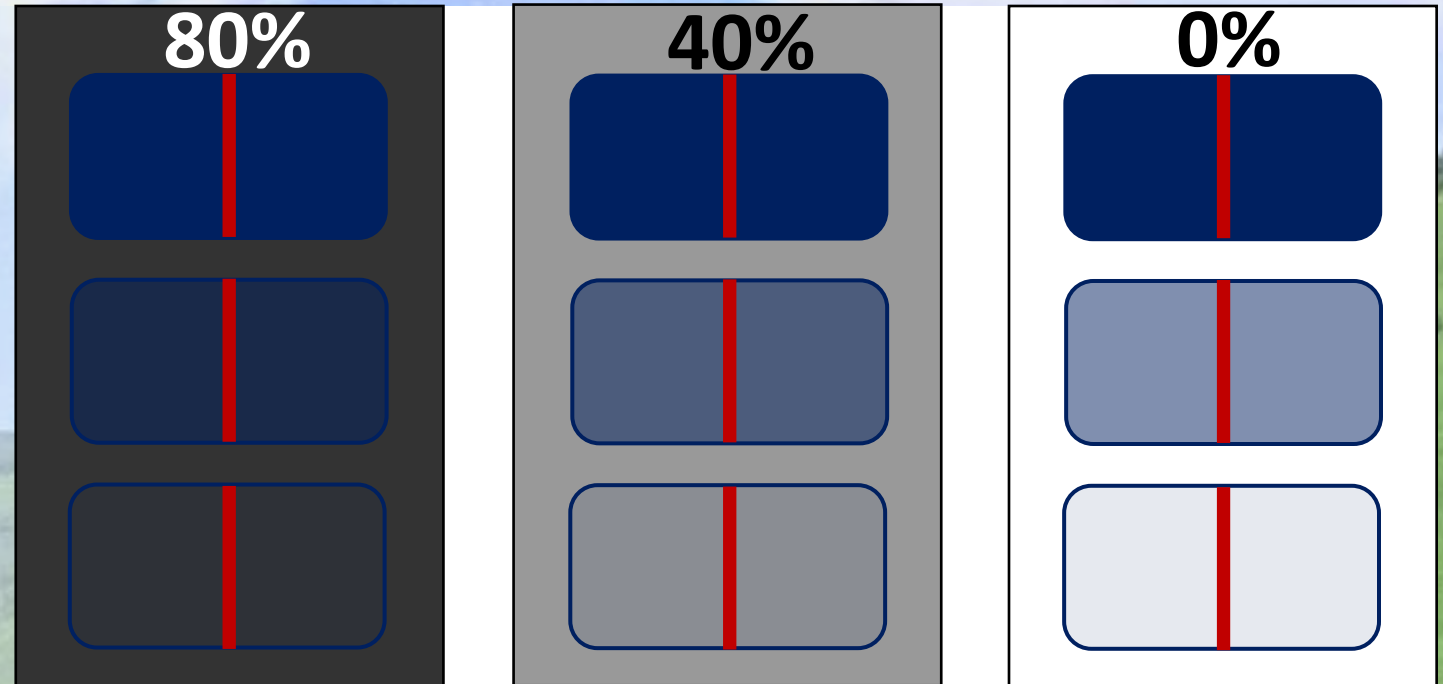
- High (80%), medium (40%) & low (0%) shade density
- High (every day), medium (every 3<sup>rd</sup> day) & low (every 5<sup>th</sup> day) water



# Trial design

## Treatments

- High (80%), medium (40%) & low (0%) shade density
- High (every day), medium (every 3<sup>rd</sup> day) & low (every 5<sup>th</sup> day) water
- 100 Buried ( $\approx 5\text{mm}$ ) & surface planted seed



**18 treatment combinations**



# Water

High Medium Low

0%

Shade

40%

80%





# Water

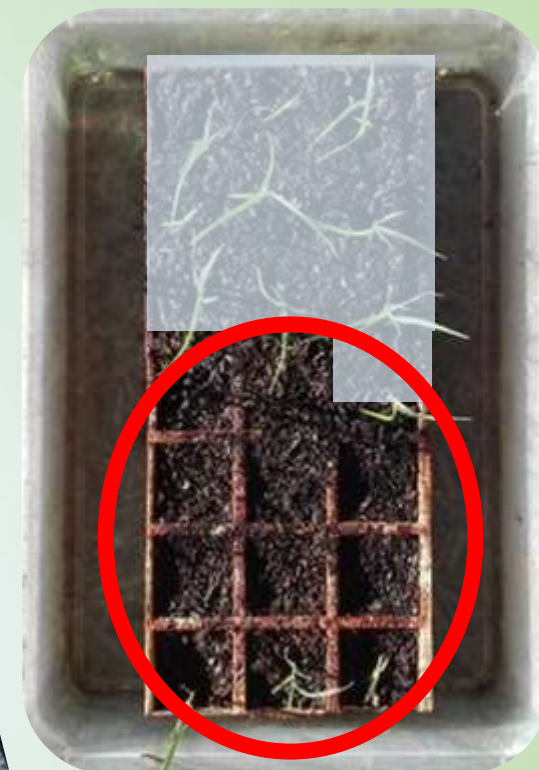
High Medium Low

Shade

0%

40%

80%





Recorded:

- From 100 seeds per treatment
  - Total germination 10 DAP





Recorded:

- From 100 seeds per treatment
  - Total germination 10 DAP
- From 10 seedlings per treatment

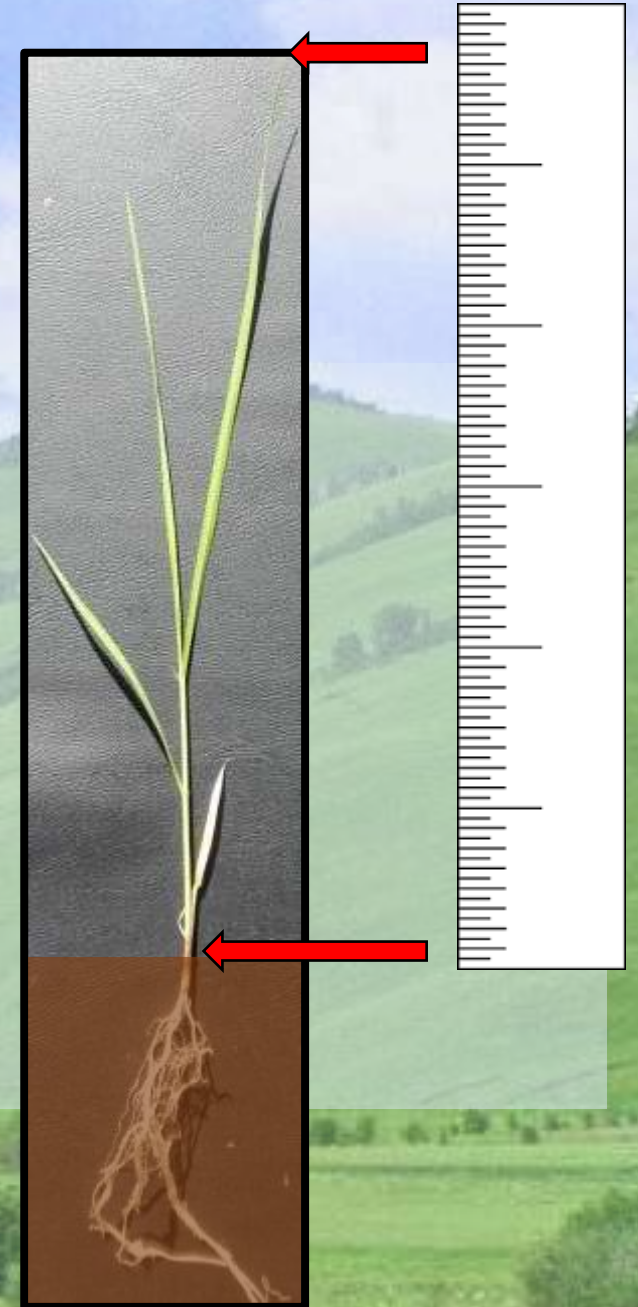


1 seedling  
per cell



## Recorded:

- From 100 seeds per treatment
  - Total germination 10 DAP
- From 10 seedlings per treatment
  - Growth from 10 DAP (initial height) to 24 DAP (final height)
  - Survival 24 DAP





## Recorded:

- From 100 seeds per treatment
  - Total germination 10 DAP
- From 10 seedlings per treatment
  - Growth from 10 DAP (initial height) to 24 DAP (final height)
  - Survival 24 DAP
  - Number of leaves
  - Above and below ground biomass (work in progress)





# Main effects

## **Shade**

- Seedling growth

## **Water**

- Germination
- Growth
- Survival

## **Planting method**

- Germination
- Growth
- Survival

# Shade density affect on growth

40%

0%

80%

**Highest**

**Intermediate**

**Lowest**





# Water availability affect on germination, growth and survival



**High**

Highest germination success, greatest growth, highest survival



**Medium**

Low germination, low growth, low survival



**Low**

Low germination, low growth, low survival



# Planting method affect on germination, growth and survival



**Buried**

High germination, greater growth, high survival

**Surface**

Low germination, low growth, low survival



# Interaction effects

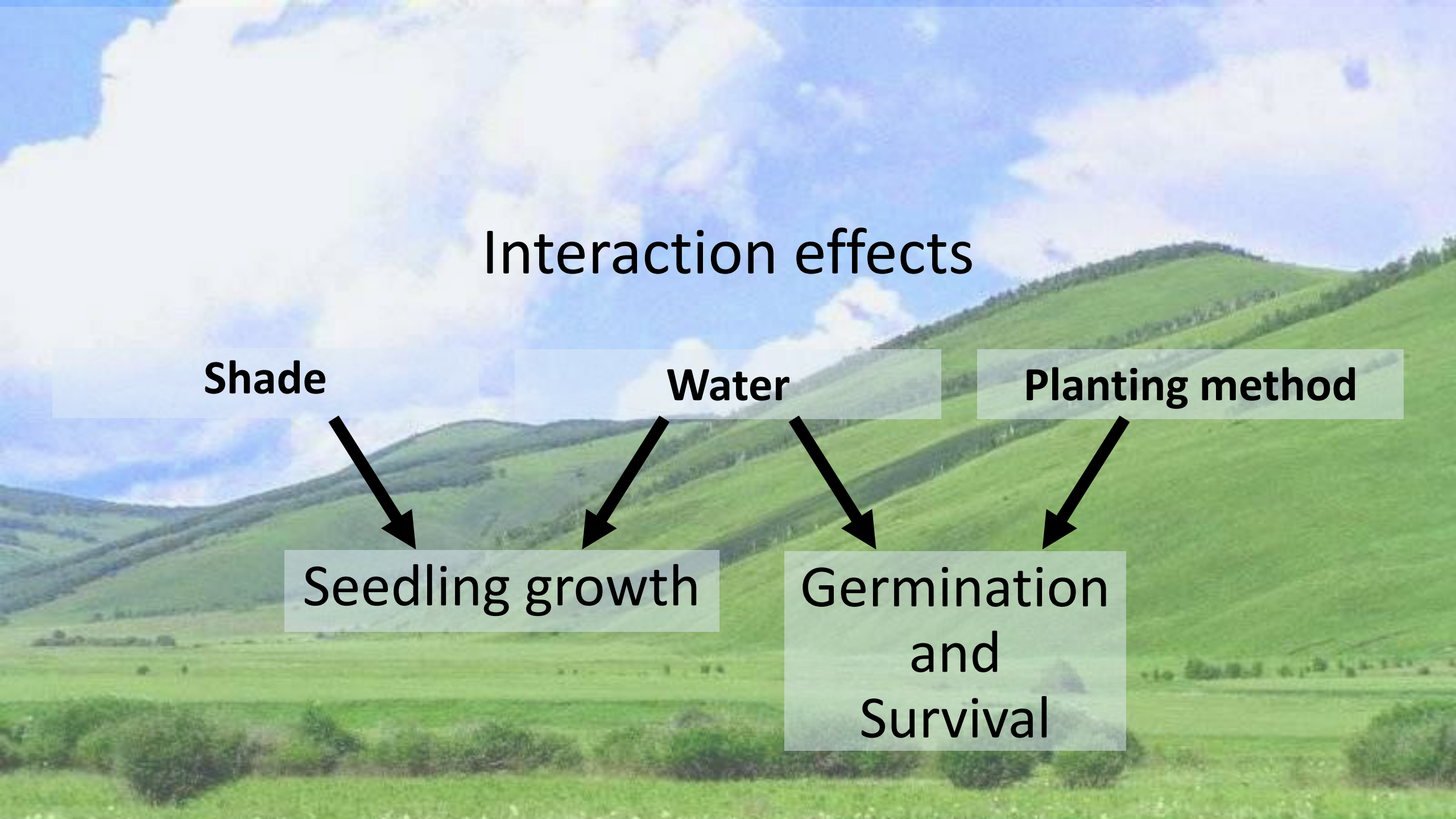
**Shade**

**Water**

**Planting method**

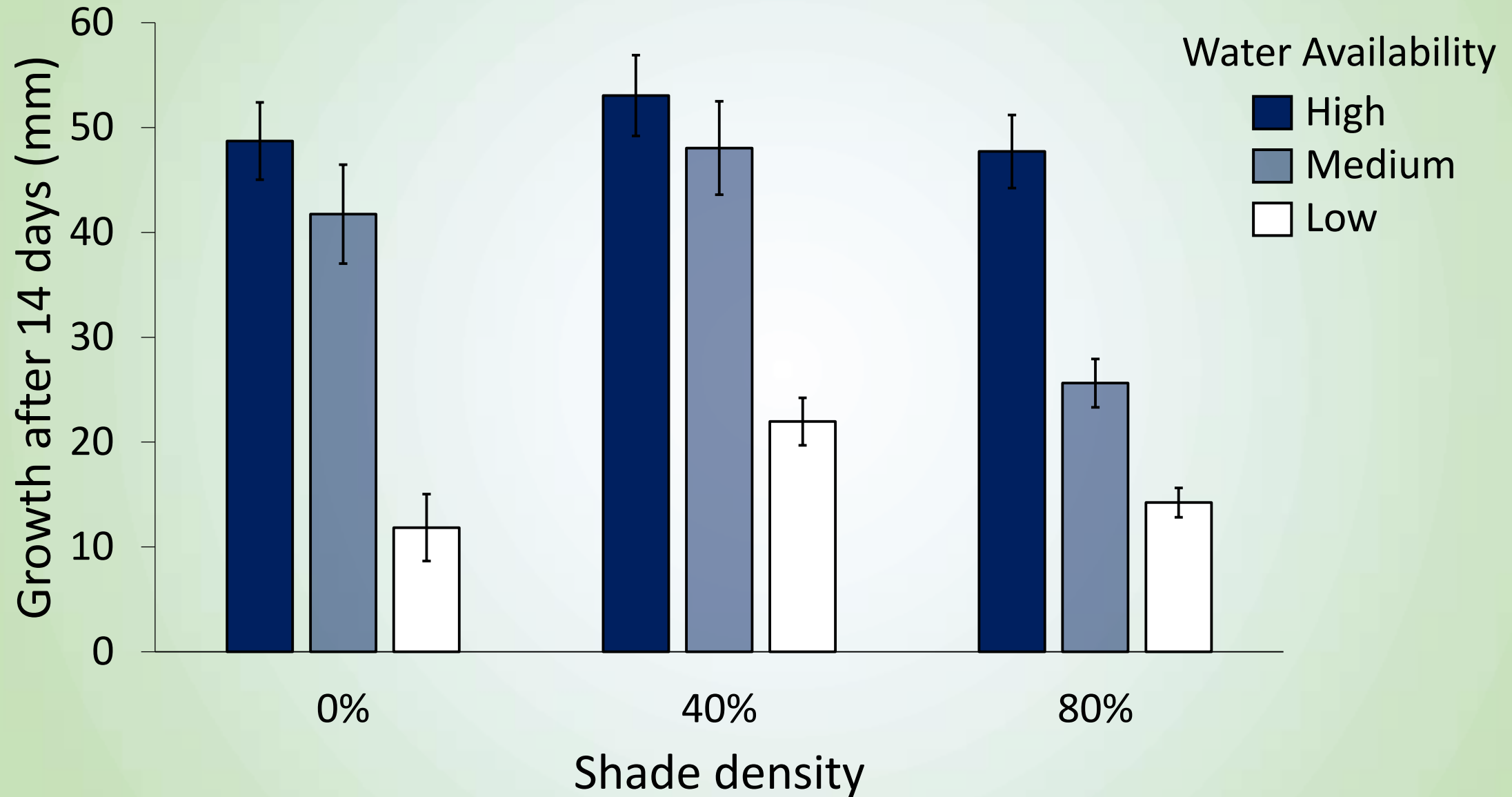
**Seedling growth**

**Germination  
and  
Survival**



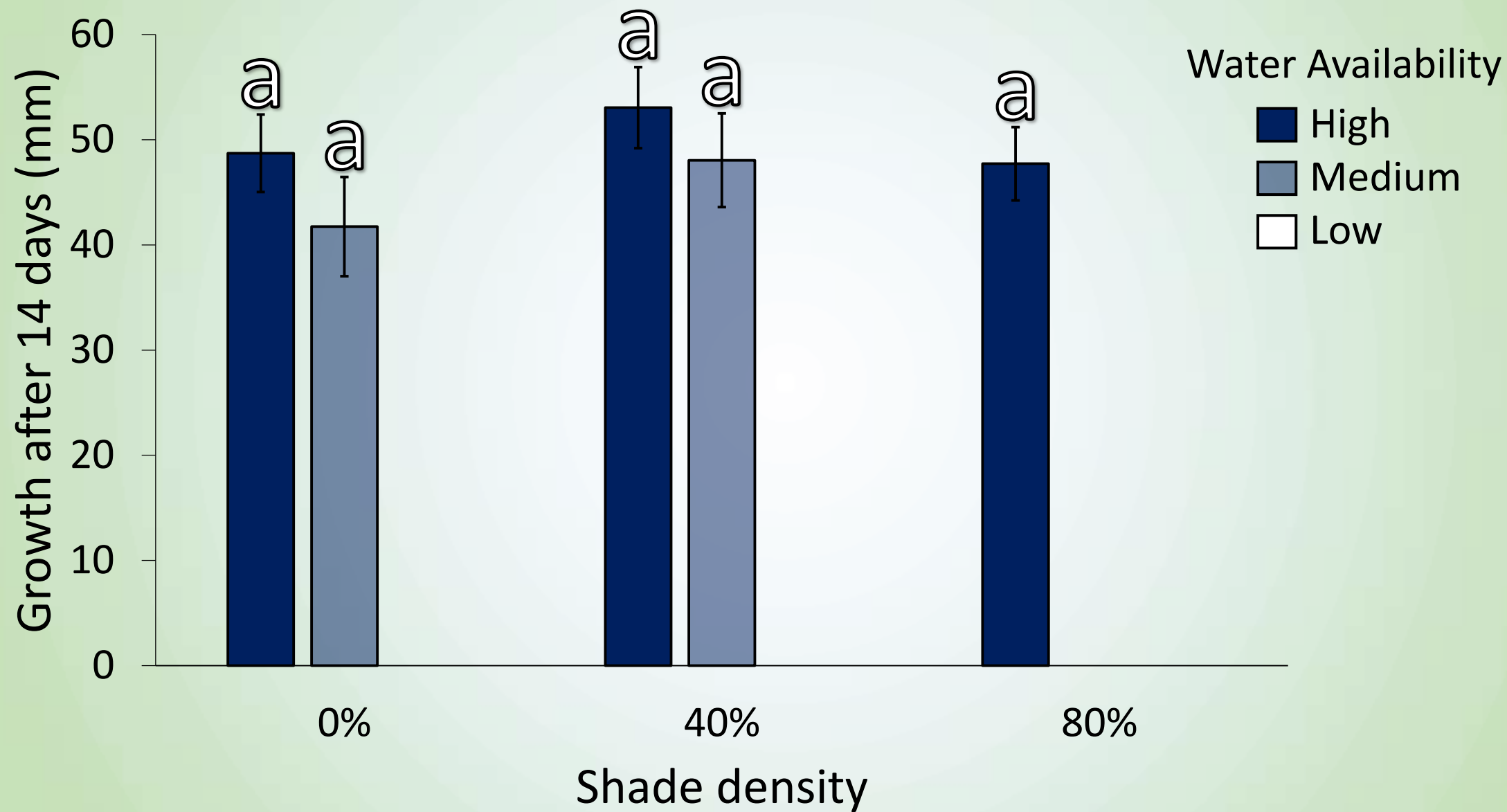


# Shade x Water affect on growth

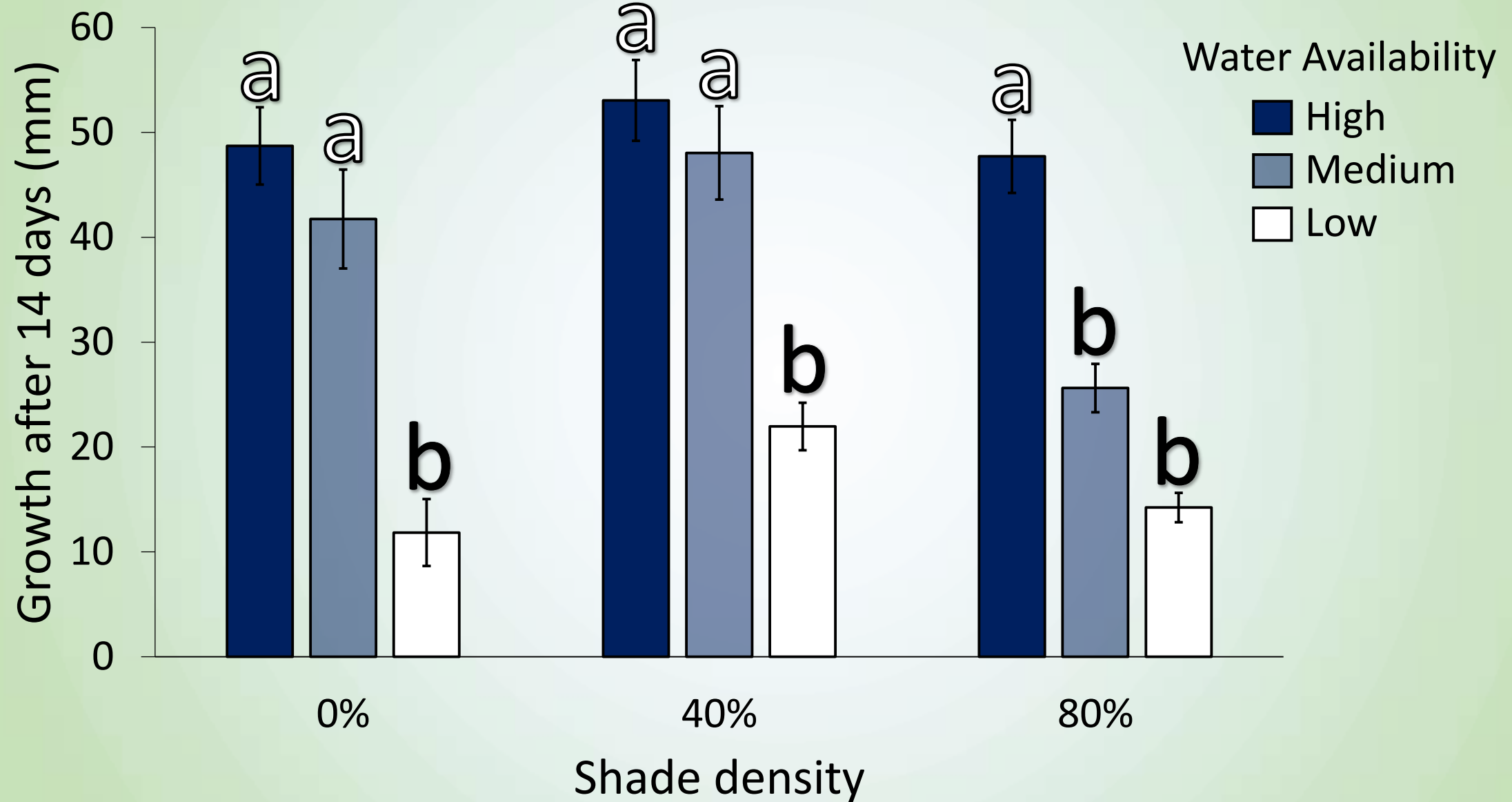




## Shade x Water affect on growth



## Shade x Water affect on growth





# Burning, mowing & grazing as management techniques

## Shade x Water

Water availability high - no special light intensity requirements for seedling growth.

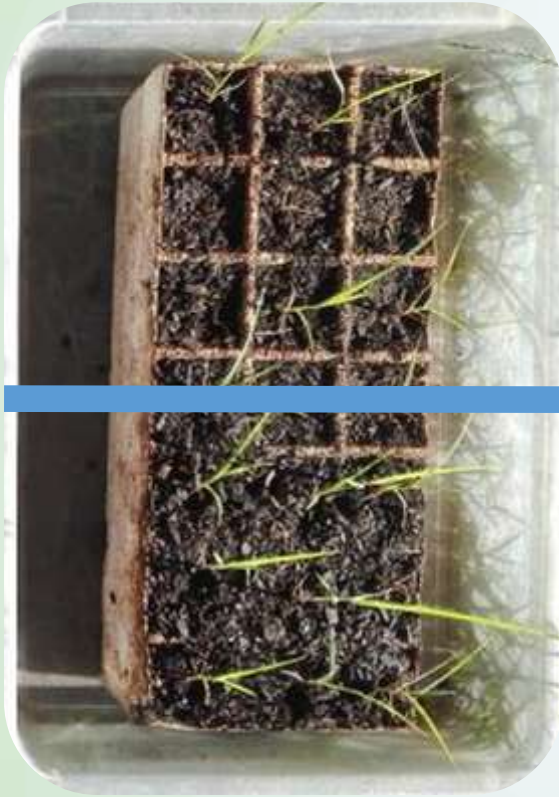
Implies that water availability is more NB than light intensity for growth.

Water availability low - shade NB for growth, with seedlings growing better under moderate canopy cover.

Implies that low light intensity is NB for seedling growth in an arid environment.

# Water x Planting affect on germination and survival

**Surface**

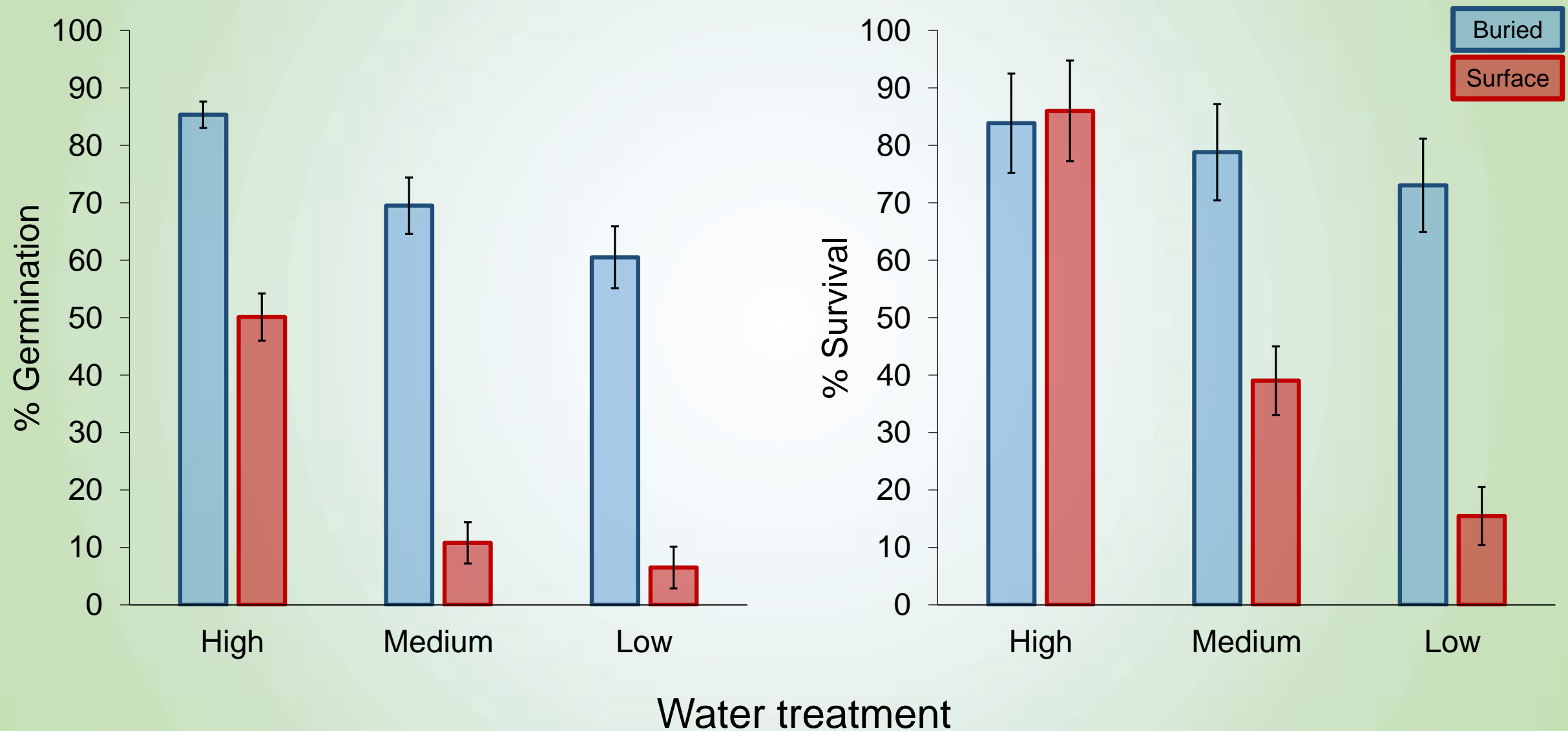


**Buried**

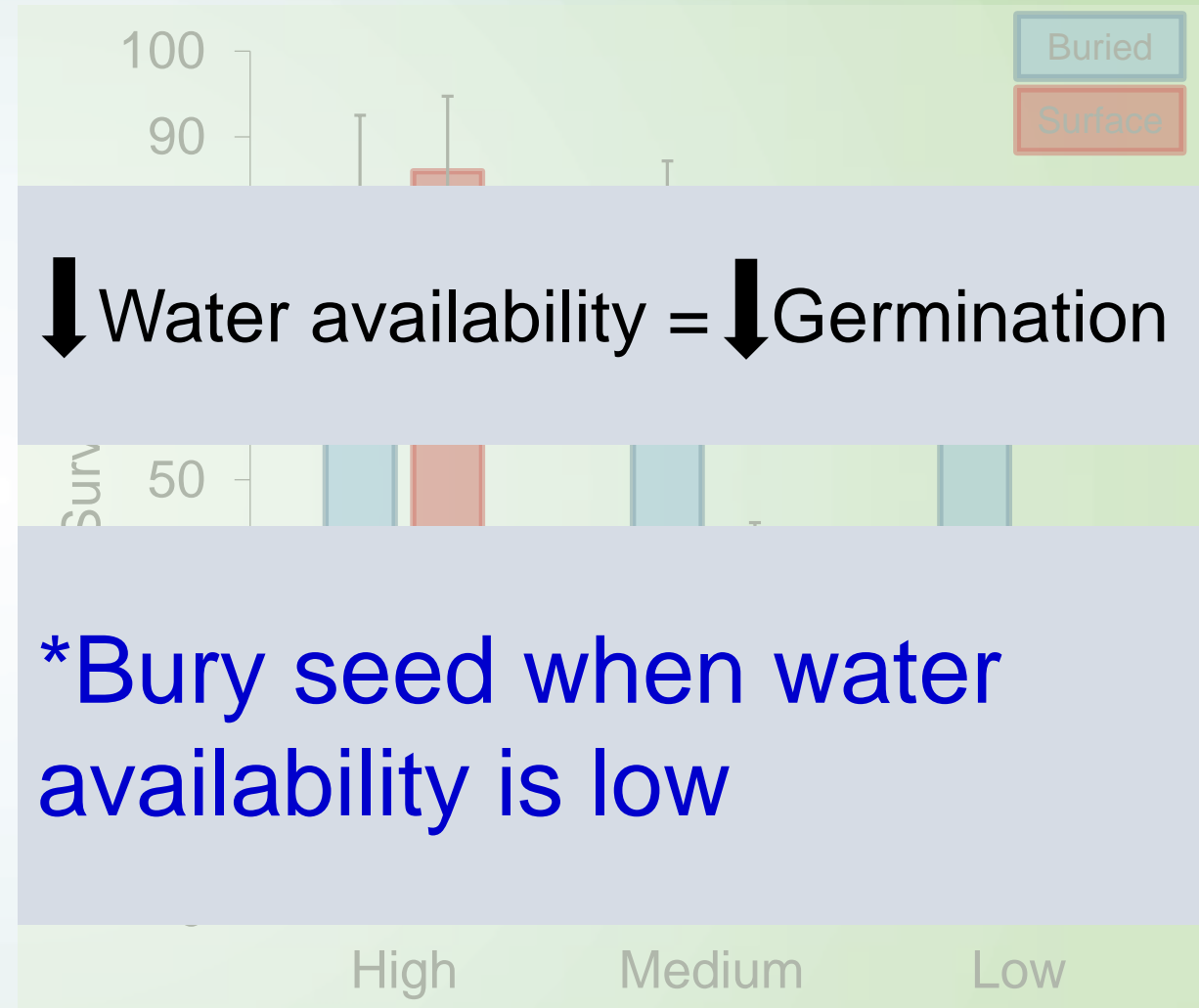
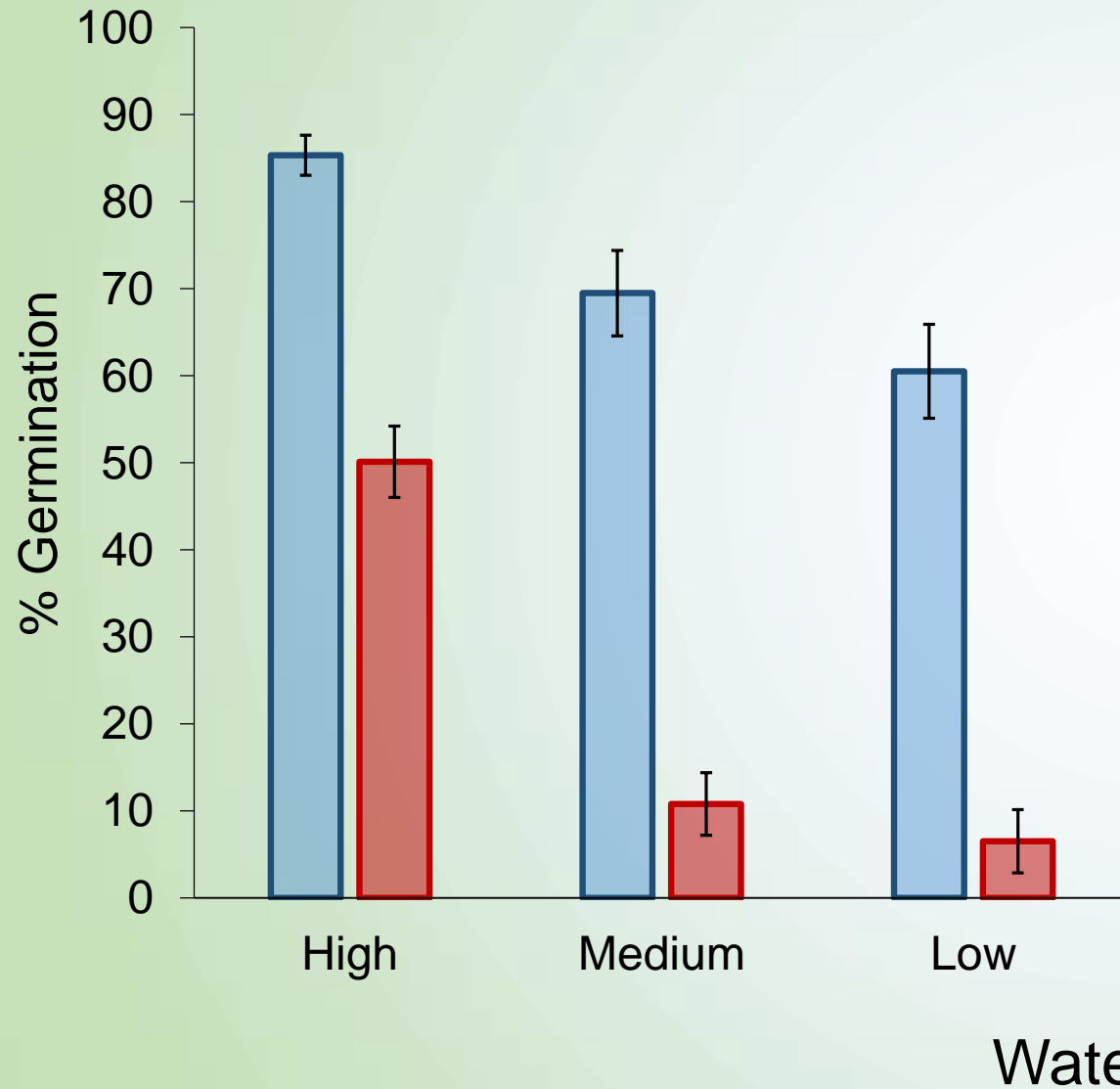




# Water x Planting affect on germination and survival

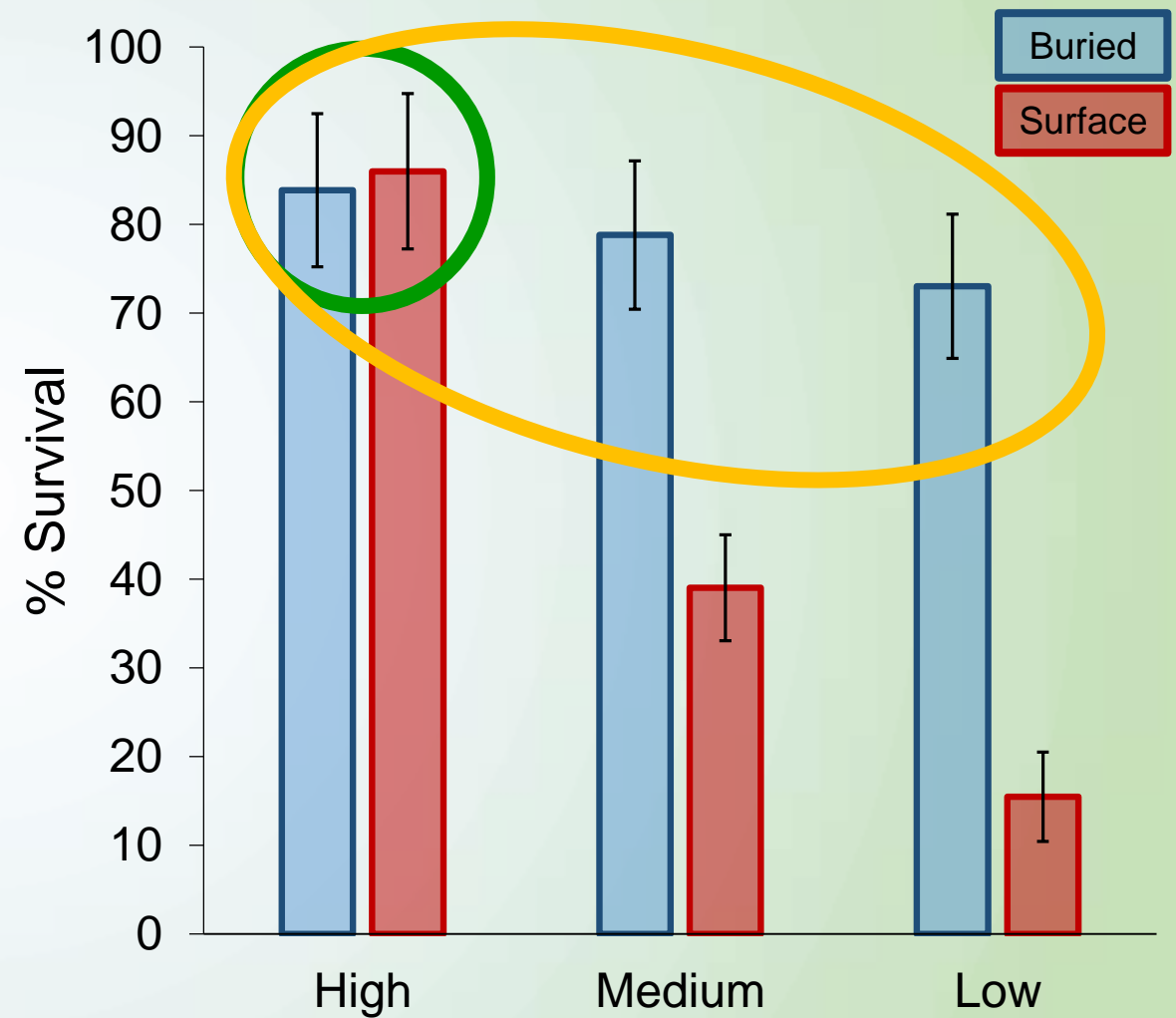
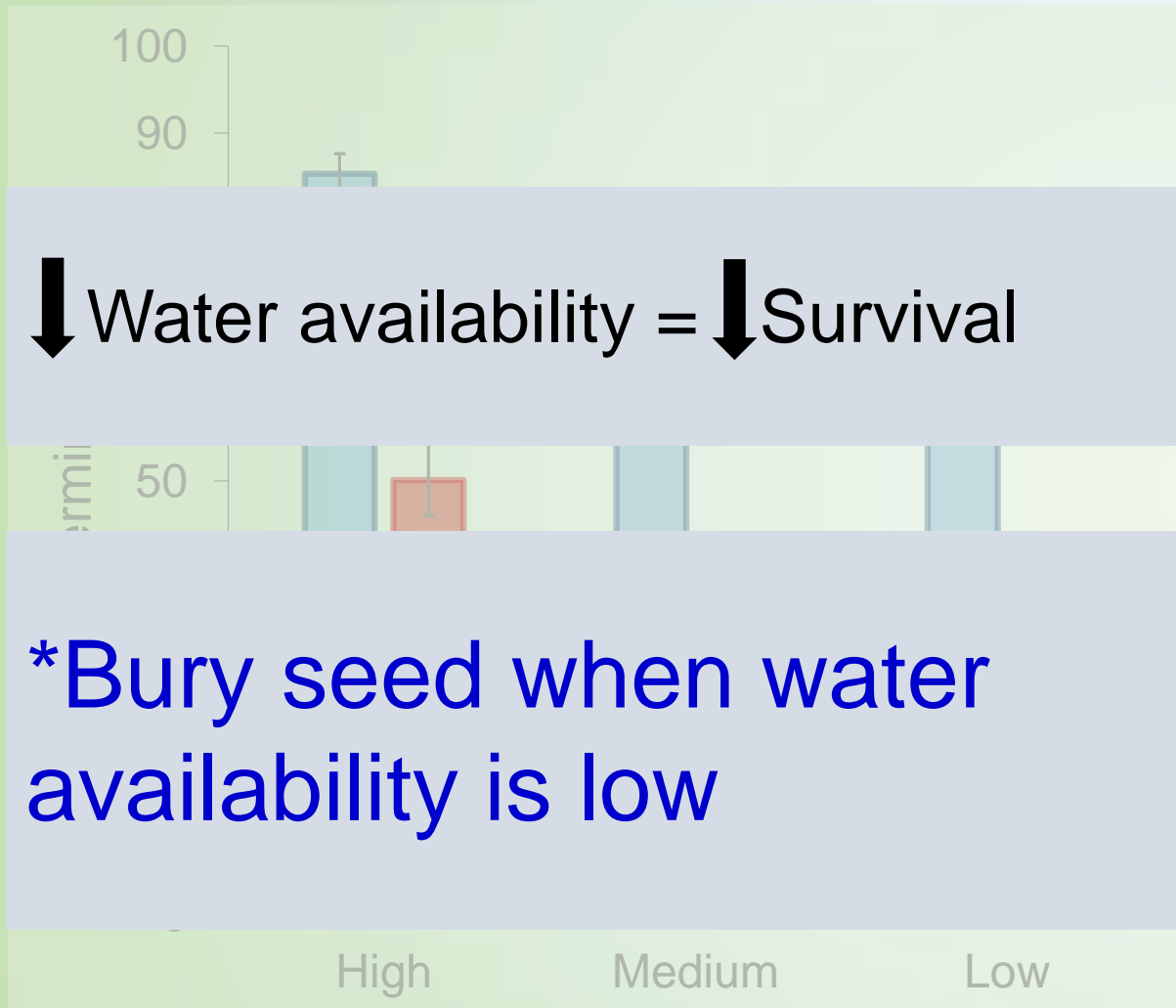


# Water x Planting affect on germination and survival





# Water x Planting affect on germination and survival



Water treatment

# Burning, mowing & grazing as management techniques

## Water x Planting

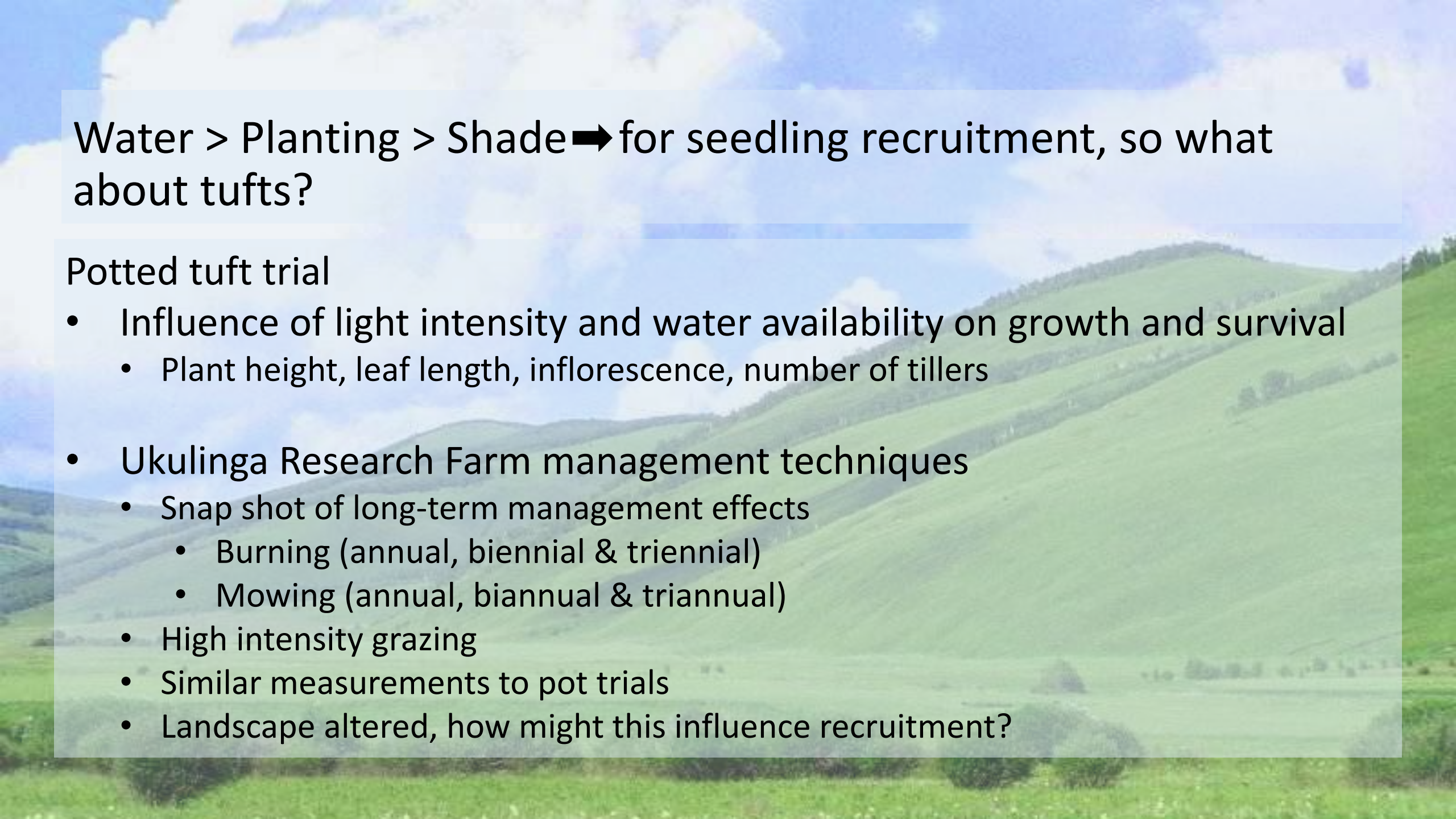
Water availability high - no special planting requirements for seedling emergence and survival.

Implies that water availability is more NB than planting method for emergence and survival.

Water availability low, burying seed is beneficial - trampling assists in emergence and survival.

Especially NB in arid environments - seeds need moderate soil compaction to make contact with moisture in the soil.





Water > Planting > Shade ➡ for seedling recruitment, so what about tufts?

### Potted tuft trial

- Influence of light intensity and water availability on growth and survival
  - Plant height, leaf length, inflorescence, number of tillers
- Ukulinga Research Farm management techniques
  - Snap shot of long-term management effects
    - Burning (annual, biennial & triennial)
    - Mowing (annual, biannual & triannual)
  - High intensity grazing
  - Similar measurements to pot trials
  - Landscape altered, how might this influence recruitment?



# Thank you

## Acknowledgements

National Research Foundation for project funding

Michelle Tedder, Kevin Kirkman and Craig Morris for guidance

Bruce Lyle, Mark Summers and Doug Makin for assistance with trial set up and data collection

## Image references

1. [https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcQscIDEzXk\\_Blyvao0nVHBCuKdEWNABE0mm7xnNvNuI7cdsOq5OPQ](https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcQscIDEzXk_Blyvao0nVHBCuKdEWNABE0mm7xnNvNuI7cdsOq5OPQ)
2. <http://images.wisegeek.com/teff-grains-in-hand.jpg>
3. [https://en.wikipedia.org/wiki/File:Teff\\_pluim\\_Eragrostis\\_tef.jpg](https://en.wikipedia.org/wiki/File:Teff_pluim_Eragrostis_tef.jpg)
4. <http://www.google.earth.com>, DigitalGlobe2015

