# Storage temperature and relative humidity affects the rate afterripening and viability of Heteropogon contortus seeds

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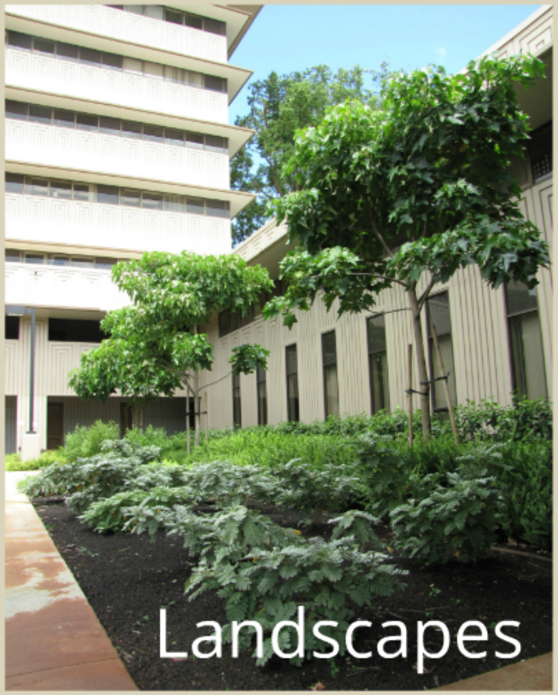
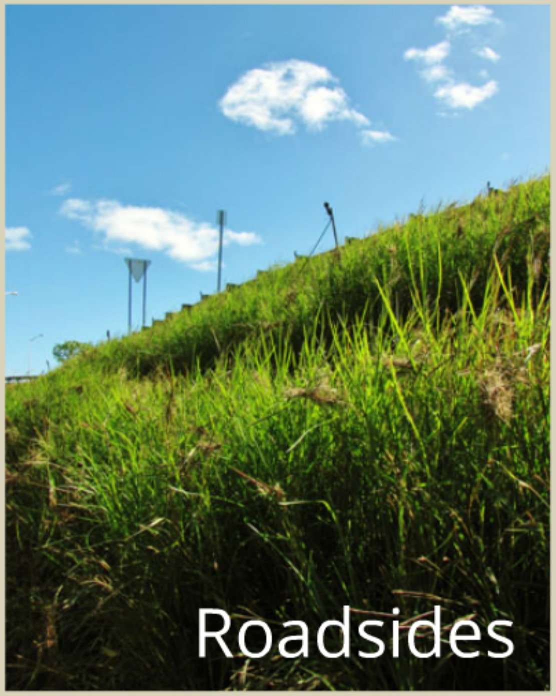
# Why is seed dormancy important in re-vegetation?

- Seed dormancy presents a challenge in re-vegetation and restoration
- It can be a hindrance during planting and establishment
- It can delay canopy fill-in, making plantings more prone to erosion and weed invasion

In Hawaii, interest in the use of native plants has increased

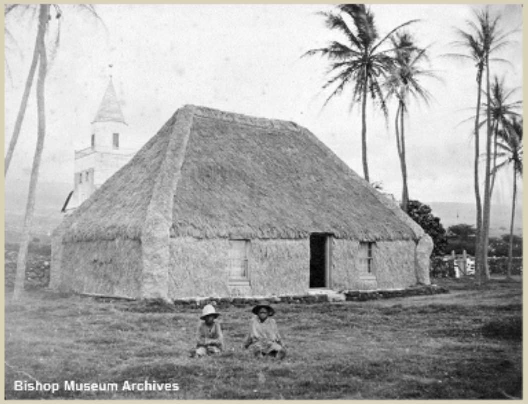




A number of plants have been identified and evaluated as potential re-vegetation species.

Studies on seed production and germination biology is needed

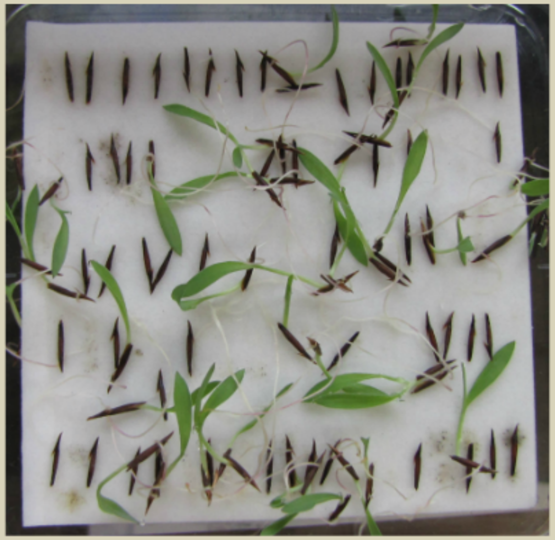
# *Heteropogon contortus* (piligrass)

- Drought tolerant native perennial bunchgrass
- In Hawaii, found on all main islands from coast to 700 m
- Adaptable to low rainfall, low nutrient soils
- Cultural and ecological value




Bishop Museum Archives

# *Heteropogon contortus* seeds possess dormancy



- Freshly harvested seeds will not germinate
- Dry after-ripening (storage) of 6 to 12 months is required, however…
- Specific storage conditions for this is unknown
- Studies indicate temperature and relative humidity/seed moisture content affects after-ripening/dormancy loss as well as seed viability

## Objective

To determine optimum storage conditions (i.e. storage temperature and relative humidity):

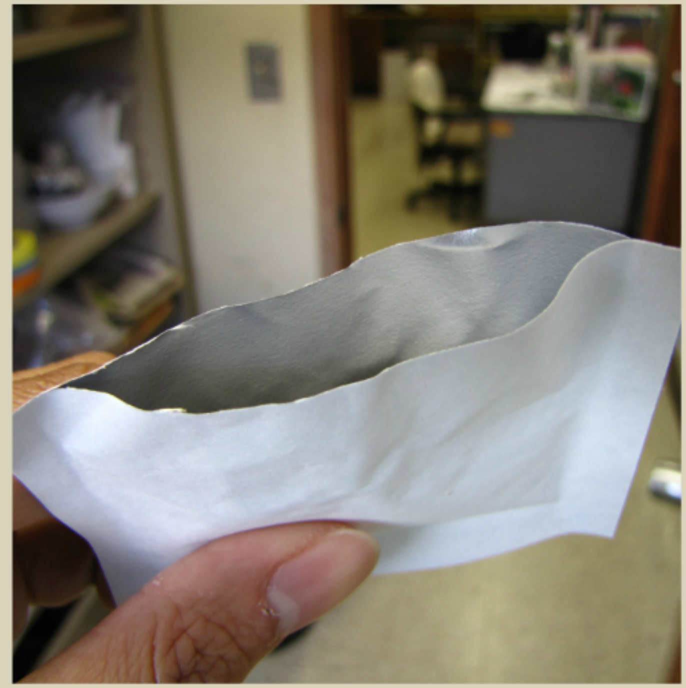
- dormancy loss
- seed viability maintenance

# Materials and methods: seed preparation

Kahoolawe Island source identified germplasm - NRCS PMC Molokai

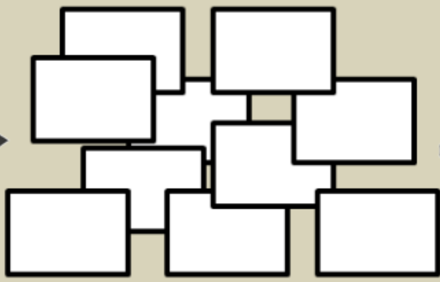
Freshly harvested seeds collected in March and October 2011

Cleaned and air dried



Seeds were placed in unsealed packets.

# Materials and methods: seed equilibriation



252 unsealed
seed packets

Dessicators with saturated salt solutions

equilibriate for 28 days

| 12% eRH LiCl | 50% eRH $Ca(NO_3)_2$ | 75% eRH NaCl |
| --- | --- | --- |
| ↓ | ↓ | ↓ |
| 6% seed moisture | 11% seed moisture | 14% seed moisture |

dry weight basis

# Materials and methods: storage temperature

heat sealed to maintain moisture content

**warm, 30°C**
- 12% eRH
- 50% eRH
- 75% eRH

**ambient, ~20°C**
- 12% eRH
- 50% eRH
- 75% eRH

**cool,10°C**
- 12% eRH
- 50% eRH
- 75% eRH

Incubation period

0 month

1 month

3 months

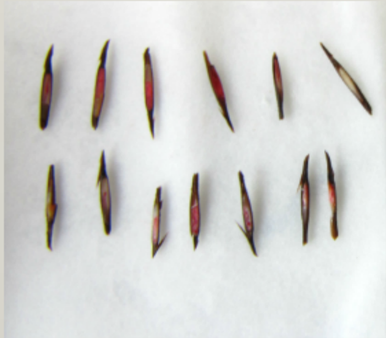
6 months

9 months

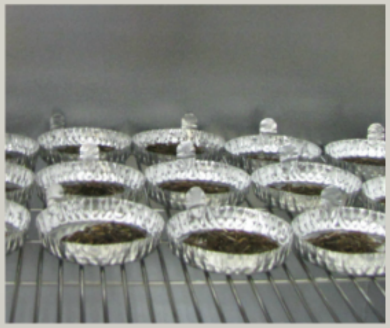
12 months

Germination test

Tetrazolium seed viability tests



Percent moisture



# Statistical analysis

## Seed germination counts
## Tetrazolium counts

- Generalized linear mixed model (PROC GLIMMIX, binomial distribution, logit link function)
- Tukey Kramer mean separation

## Percent moisture

- Square root transformed
- Analysis of variance
- Tukey HSD mean comparison

## Results

- Percent moisture (dry weight basis): Each relative humidity treatment maintained a specific seed moisture content throughout the experiment

  - At 12% eRH: 6% seed moisture content
  - At 50% eRH: 11% seed moisture content
  - At 75% eRH: 14% seed moisture content

- Percent germination: Storage conditions for after-ripening/dormancy loss

## March 2011 seeds

Percent germination scale

| | |
|---|---|
| all germinated | 100 |
| | 75 |
| | 50 |
| | 25 |
| all dormant | 0 |

Months in incubation

| Equilibrium relative humidity | Temperature | 0 | 1 | 3 | 6 | 9 | 12 | |
|---|---|---|---|---|---|---|---|---|
| 12 | <3% germination 10°C still dormant | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | |
| 50 | | 0.5 | 1.0 | 1.0 | 2.0 | 2.0 | 3.0 | |
| 75 | | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 | |
| 12 | dormancy loss ~20°C observed | 1.0 | 0.0 | 0.5 | 2.8 | 3.2 | 7.1 | |
| 50 | | 0.0 | 0.0 | 1.3 | 16.5 | 32.7 | 53.0 * | 50% eRH, ~20°C |
| 75 | | 0.0 | 0.0 | 0.3 | 0.5 | 2.1 | 6.7 | |
| 12 | dormancy loss 30°C observed | 0.0 | 1.0 | 18.5 | 74.6 | 81.3 | 73.7 * | **12% eRH, 30°C** |
| 50 | | 0.0 | 1.0 | 21.6 | 67.4 | 65.8 | 69.3 * | **50% eRH, 30°C** |
| 75 | | 0.0 | 0.0 | 1.0 | 9.8 | 8.3 | 2.5 | |

* not significantly different from each other

Same observation holds true for October 2011 dataset.

- Low temperature (10°C) maintained/slowed down dormancy loss.
- Best storage conditions for dormancy loss:
  - 12% eRH (6% seed moisture) and 30°C
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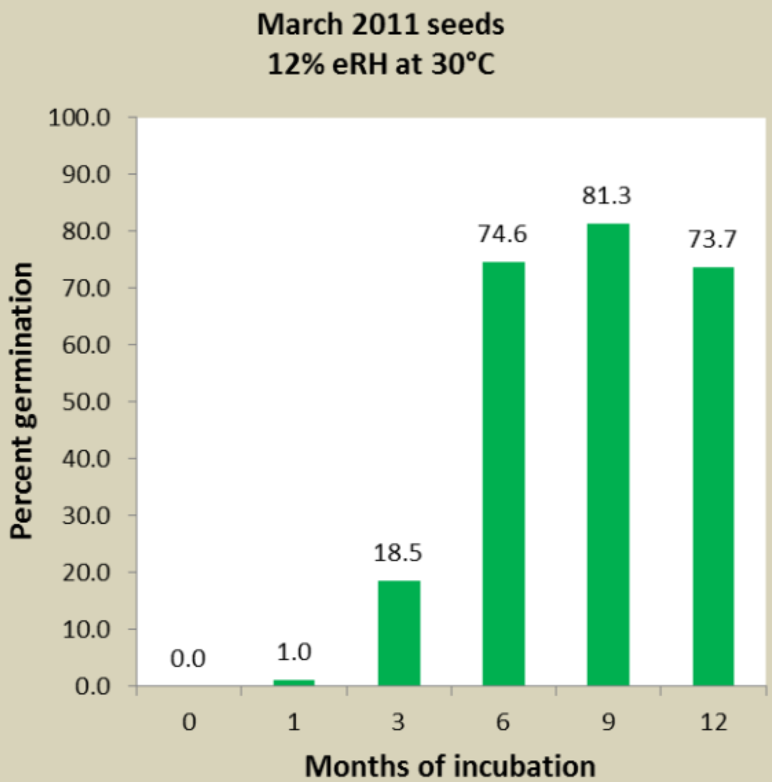
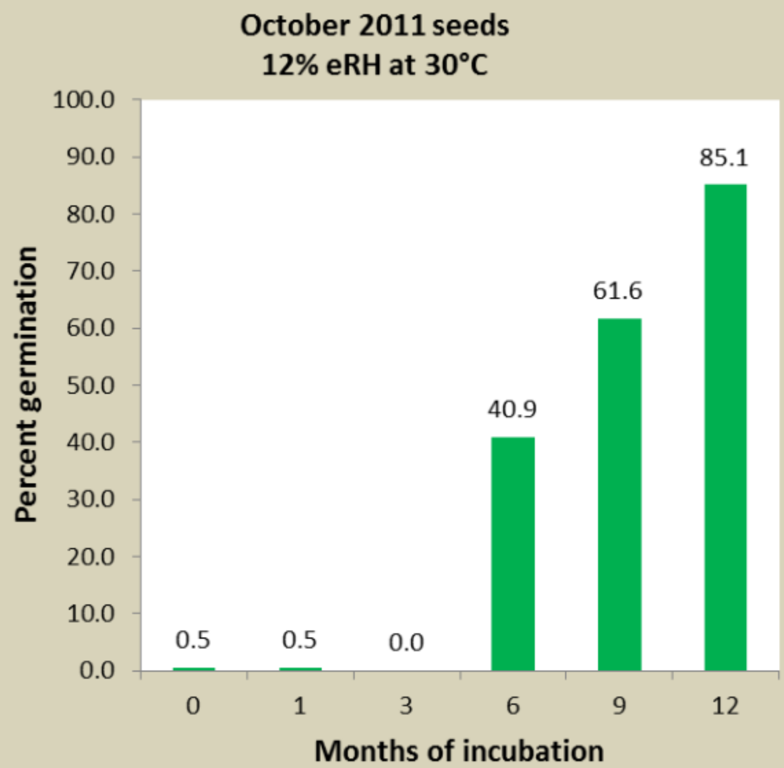
# Percent germination: Dormancy loss over time in the optimum storage conditions (12% eRH at 30°C)




Differences in depth of dormancy may be due to the growing conditions during seed development

Climate data revealed differences in growing conditions of the two seed batches

## Climate data revealed differences in growing conditions of the two seed batches

March 2011

- increasing daylength
- average temp: 21.5°C
- increasing solar radiation
- maturity: 111 days
- Total precipitation: 25.9 cm

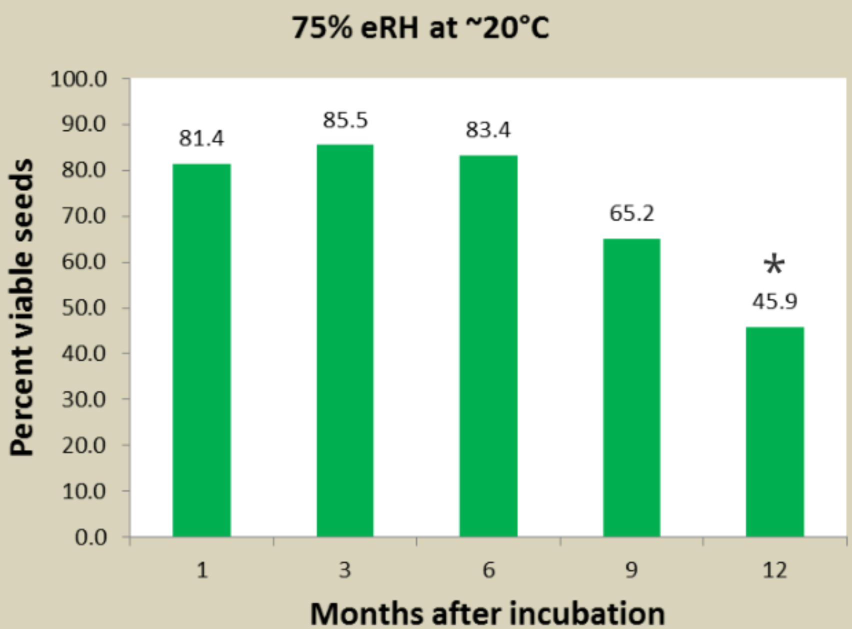
October 2011

- decreasing daylength
- average temp: 24.2°C
- decreasing solar radiation
- maturity: 94 days
- Total precipitation: 1.2 cm

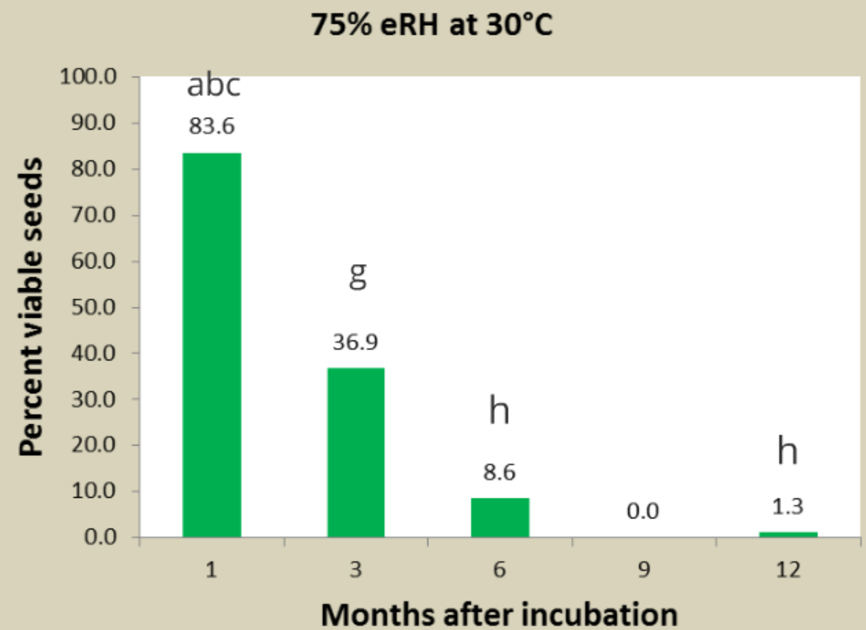
Although climate data suggests differences, further studies are recommended to confirm and tease out these effects

- Tetrazolium viability test: Same results for March and October seeds

Seed viability was consistently maintained in most treatments except for:




* significantly lower (P<0.05)

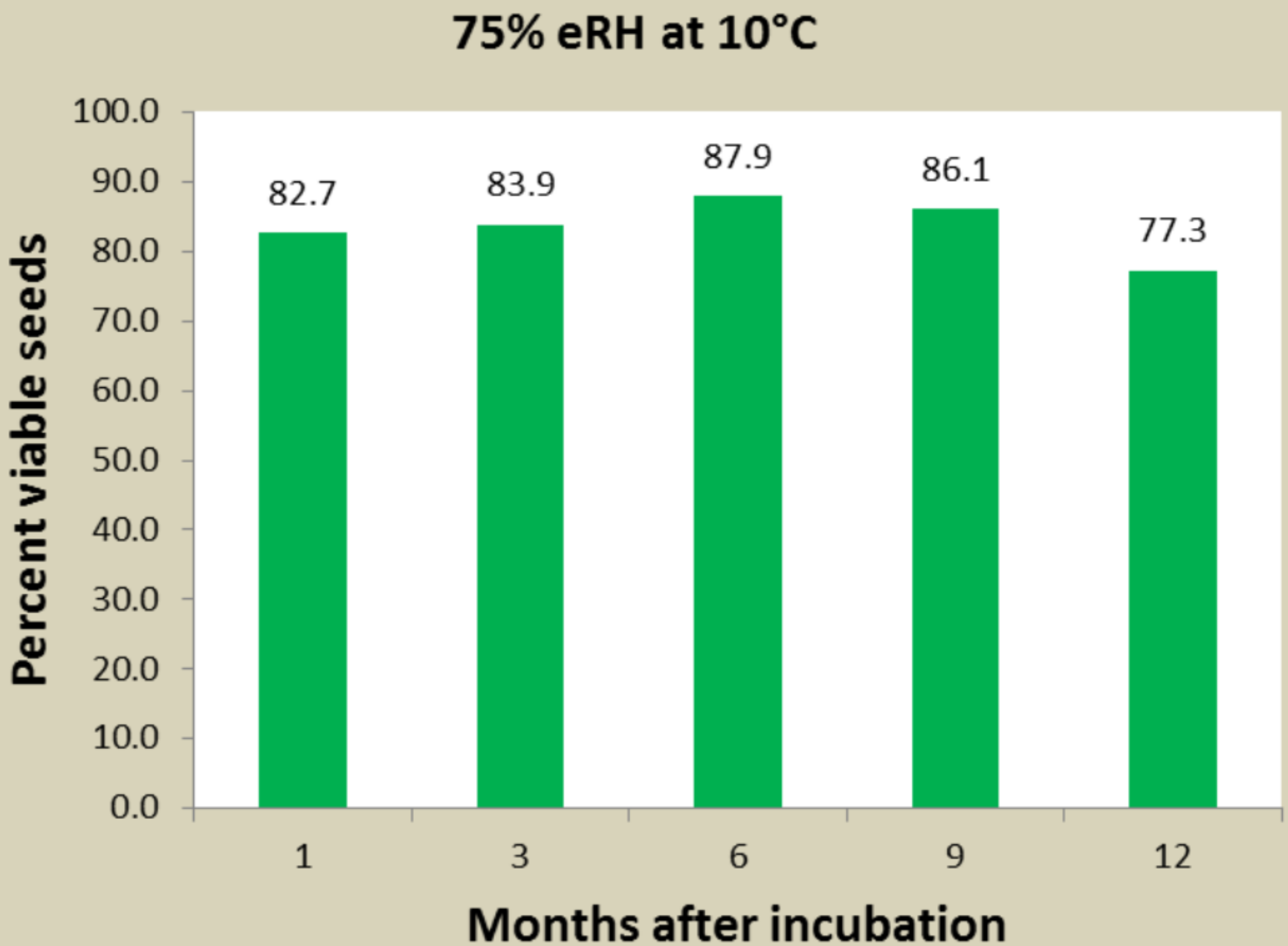



means with the same letters are not significantly different from each other (P<0.05)

Significant decline in seed viability at 12 months

Drastic decline in seed viability over time

## Tetrazolium viability test: Storage at low temperature preserves seed viability regardless of humidity




Means were not significantly different at $P<0.05$

# Conclusions

Storage temperatures and relative humidity affect after-ripening and viability of *Heteropogon contortus* seeds

For optimum after-ripening, store for a least 9 months at either:

- 12% eRH (6% seed moisture) and 30°C
- 50% eRH (11% seed moisture) and 30°C

Depth of dormancy observed between seed batches: maybe due to growing conditions

To maintain viability / maintain dormancy, store seeds at ≤10°C

Avoid storing seeds at:

- High relative humidity (75% eRH or 14% seed moisture)
- Ambient (~20°C) and high (30°C) temperatures

# Acknowledgements

DEPARTMENT OF TRANSPORTATION • STATE OF HAWAII •

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Magoon Research Facility

Matt Kramer (USDA ARS)
Tessie Amore
Peter Toves
Kai Umeda

# Overview of today's talk

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