Hygroscopic awns of two prairie grasses, *Andropogon gerardii* and *Sorghastrum nutans*

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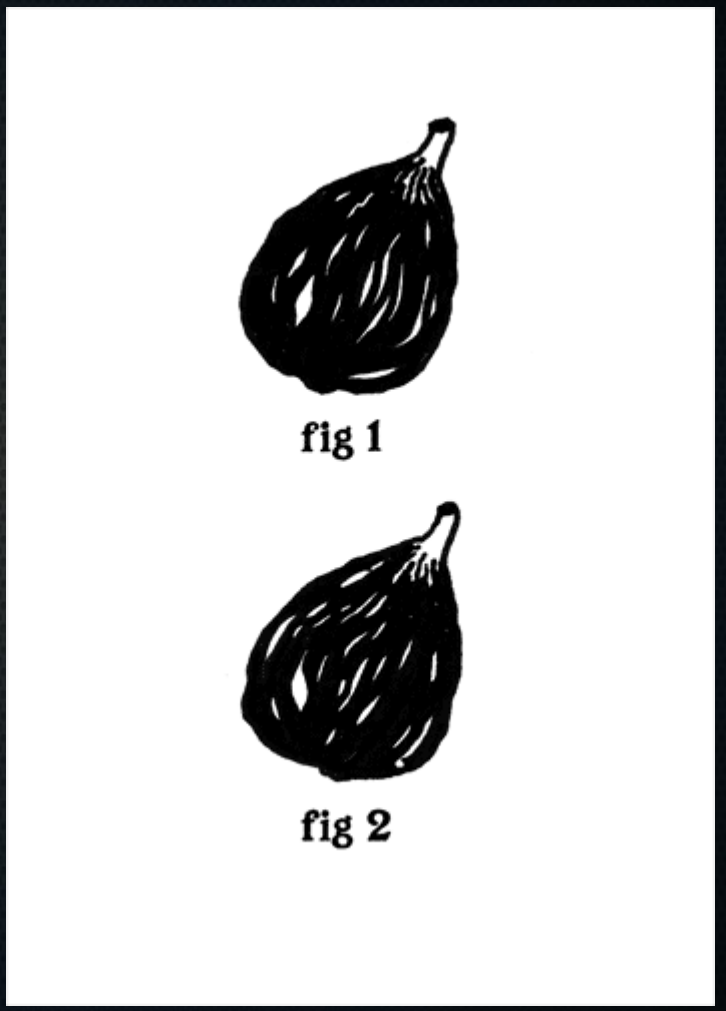
CHICAGO BOTANIC GARDEN

NORTHWESTERN UNIVERSITY

Adaptive traits

- Exhibit variation
- Variation must be heritable
- Some individuals must be more successful



Coastal sandbur (*Cenchrus spinifex)*

- Images from floridagrasses.org

Sea oats (*Uniolata paniculata)*

Sugarcane (*Saccharum giganteum)*

Grass seeds

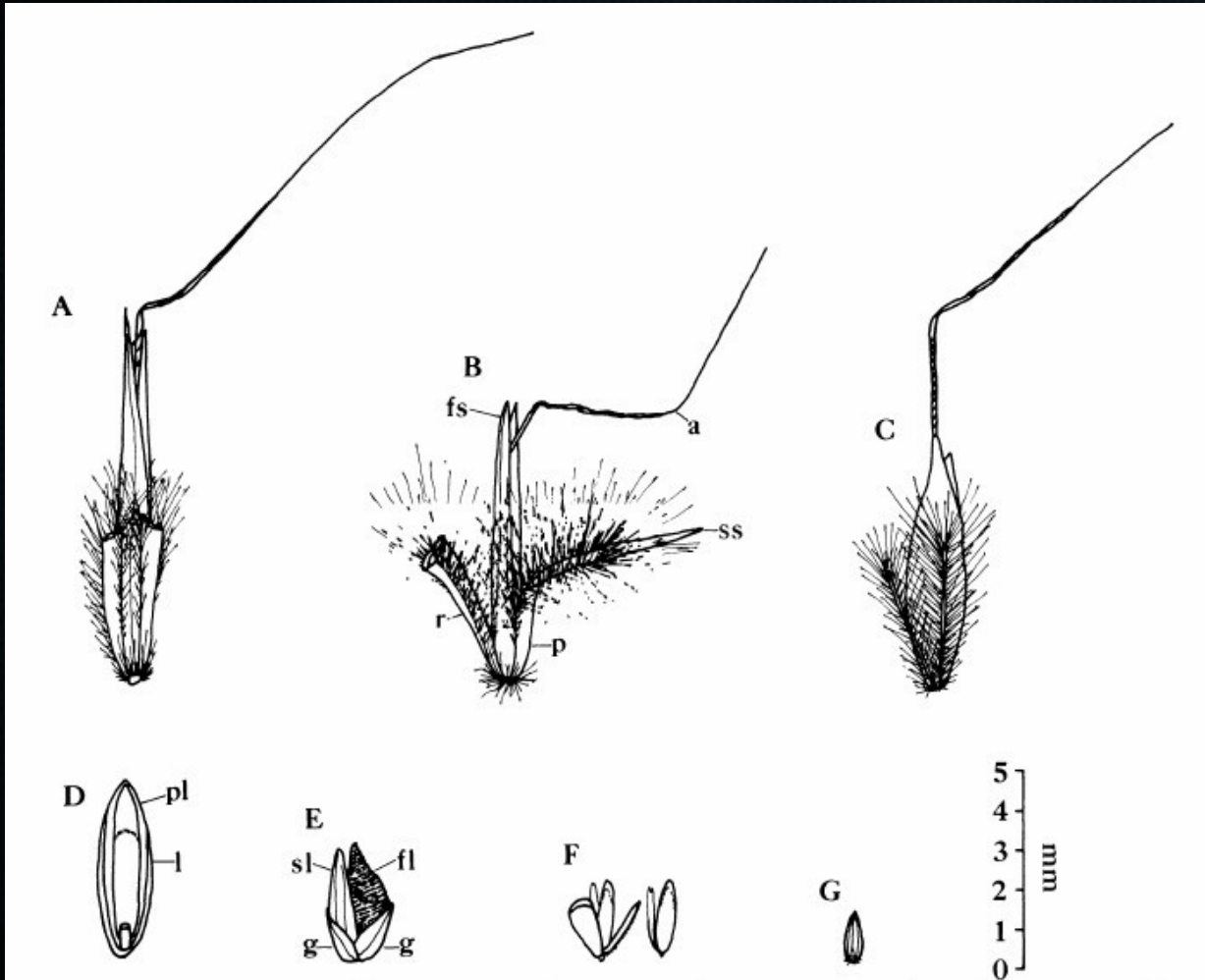
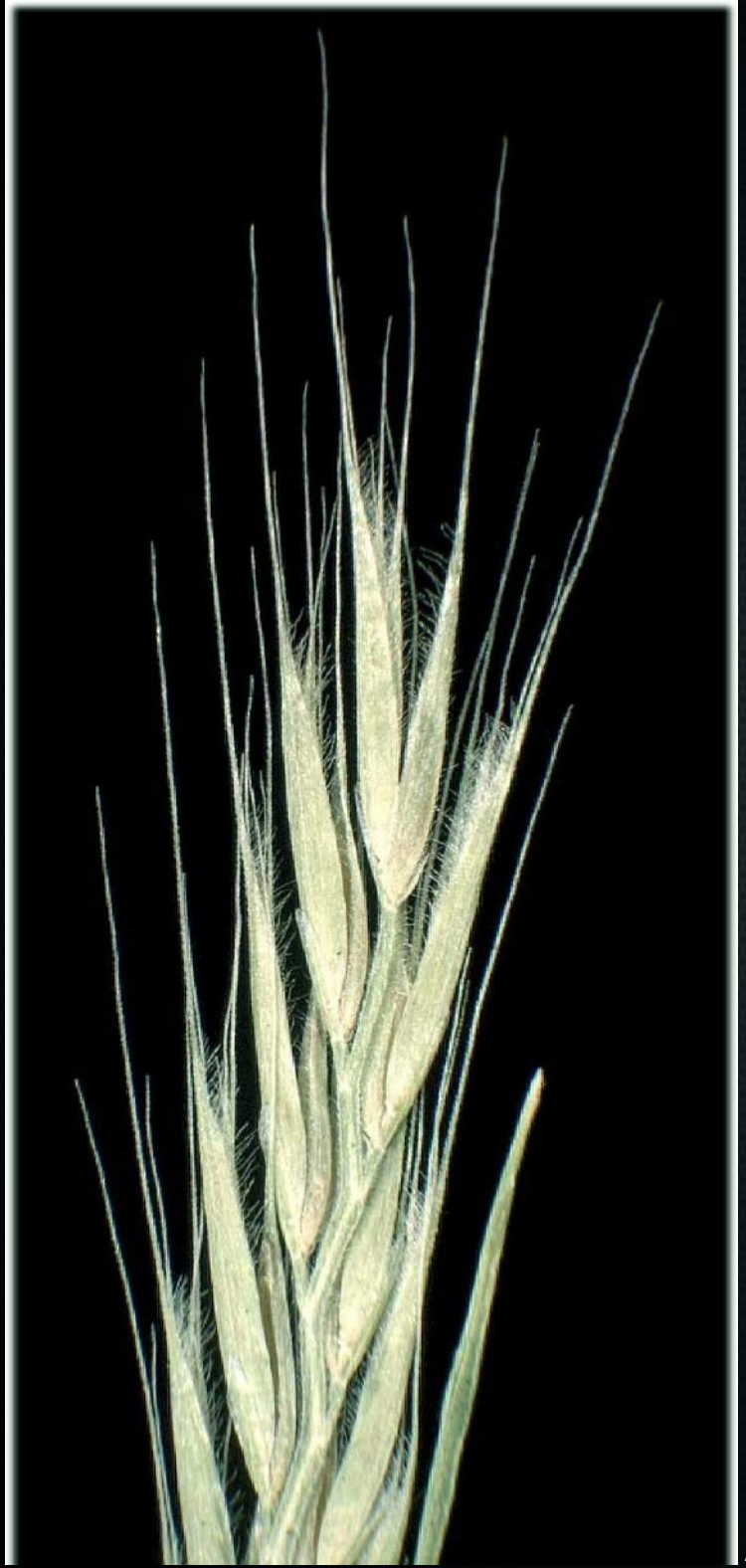


Fig. 1. Diaspores of the prairie grasses: A. *Andropogon gerardi*, B. *A. scoparius*, C. *Sorghastrum nutans*, D. *Festuca paradoxa*, E. *Setaria geniculata*, F. *Sphenopholis obtusata*, diaspore with glumes (left) and without glumes (right), and *G. Agrostis hiemalis*. Symbols: a, awn; g, glume; r, rachis segment; p, pedicel; fs, fertile spikelet, ss, sterile spikelet; l, lemma; fl, fertile lemma; and pl, palea.

- Hairs
- Size
- Shape
- Seed coats
- Bristles
- Awns



Passive awns

- Wind dispersal
- Orientation
- Protection from predators

Active awns

- Move in response to changes in humidity
- Hygroscopicity

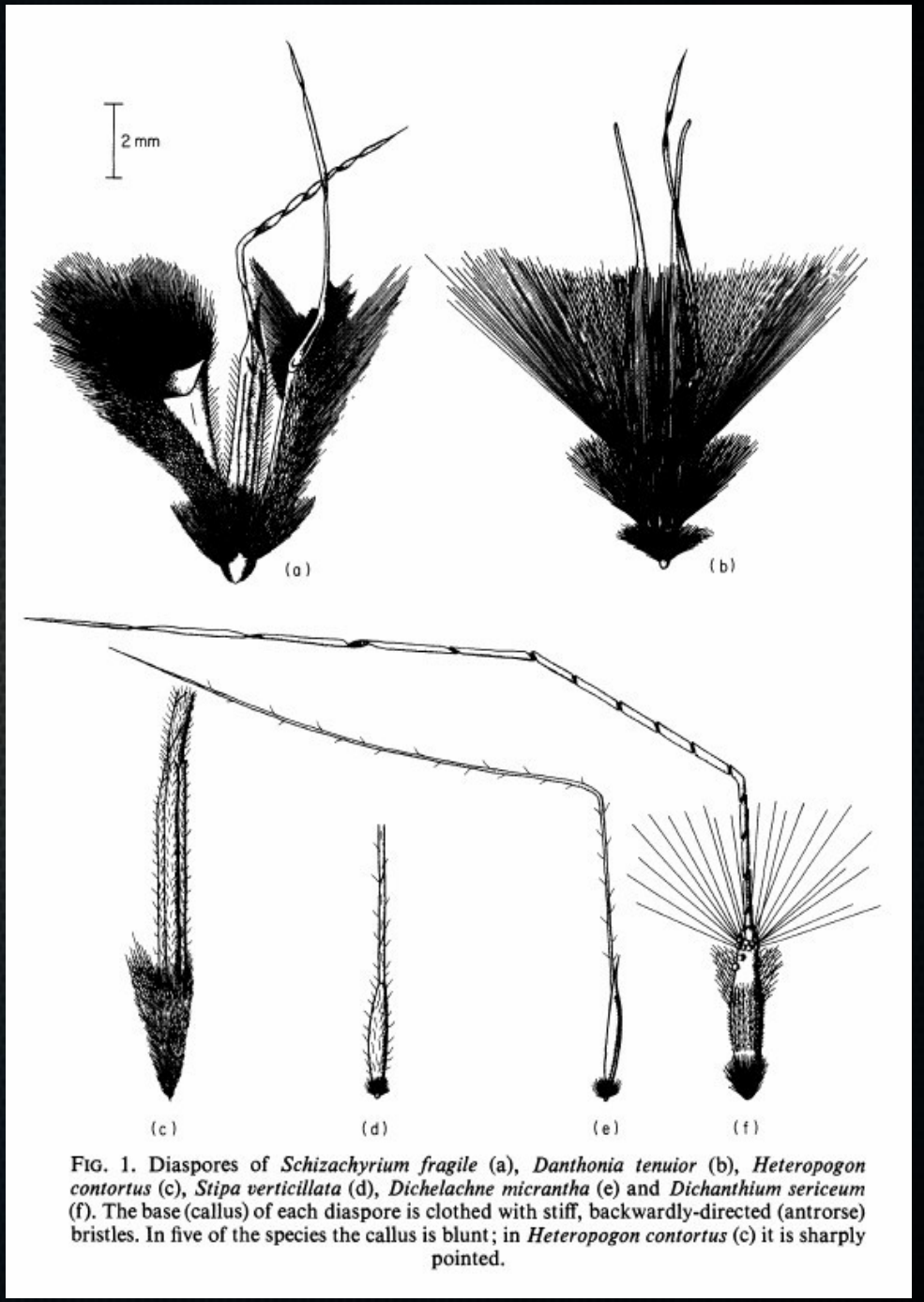
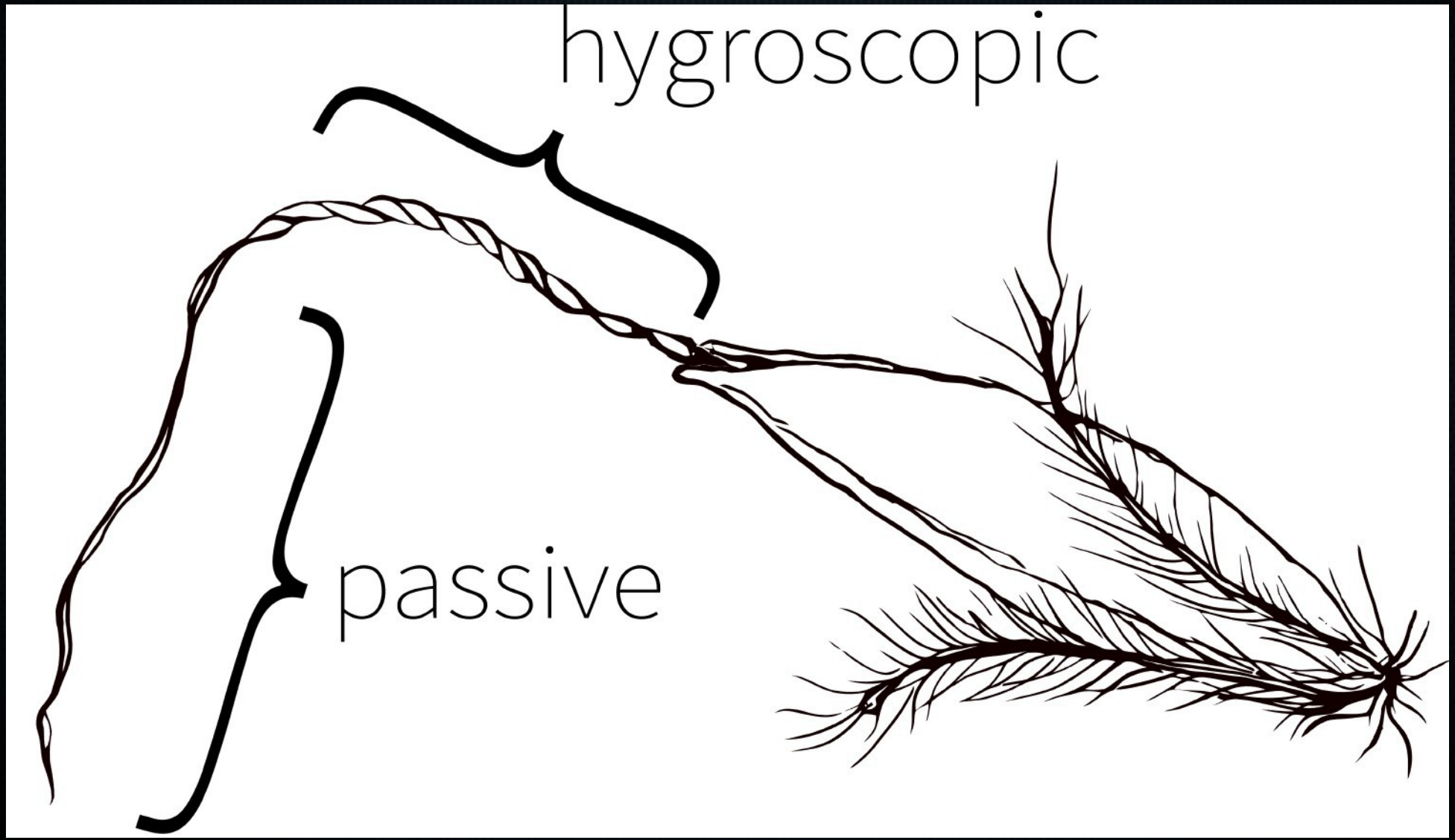


FIG. 1. Diaspores of *Schizachyrium fragile* (a), *Danthonia tenuior* (b), *Heteropogon contortus* (c), *Stipa verticillata* (d), *Dichelachne micrantha* (e) and *Dichanthium sericeum* (f). The base (callus) of each diaspore is clothed with stiff, backwardly-directed (antrorse) bristles. In five of the species the callus is blunt; in *Heteropogon contortus* (c) it is sharply pointed.

Seed morphology

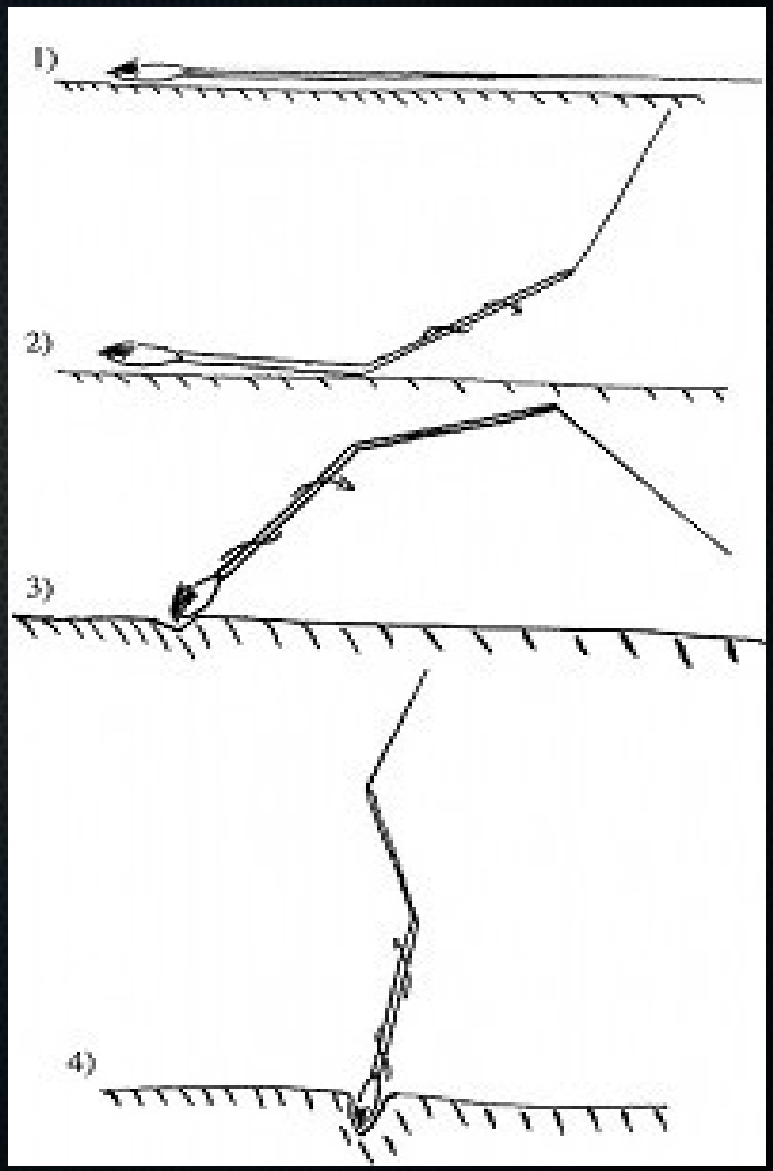


Needle and thread grass

https://www.youtube.com/watch?v=gKLjriiLWP8

Movement

- Unidirectional travel
- Burial
- Beneficial microsites



Garnier and Dajoz 2001

Prairie

- Degraded by human expansion
- Spans less than 3% of original range
- Dominant grasses: *Andropogon gerardii* and *Sorghastrum nutans*

Andropogon and *Sorghastrum*

http://www.biosci.ohio-state.edu/~asnowlab/ongoing.htm

Warner Brothers Seed Co

https://www.youtube.com/watch?v=dmjnr64jRm4

Goals

- Is the hygroscopic awn an adaptive trait?
- Heritability
- Populations
- Movement

Methods - overview

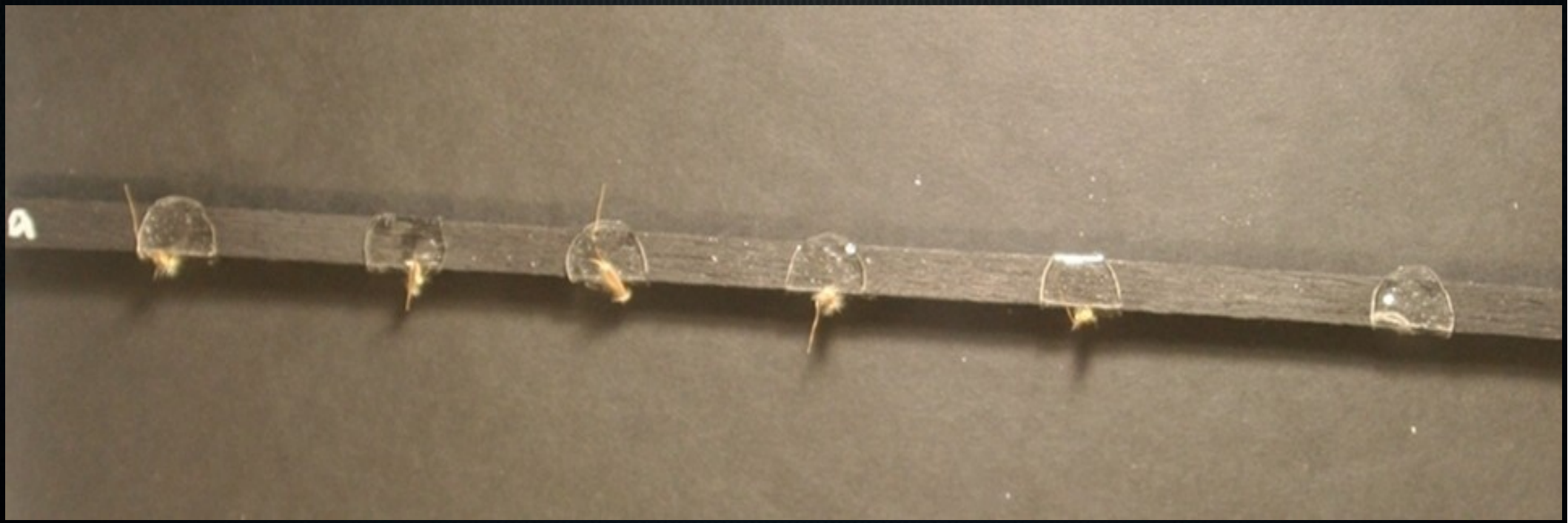
- Experiments
  - Heritability
  - Population differences
  - Ground movement
- Measured through time-lapse photography

Seed fullness

- Difficult to visually assess
- Weighed seeds, then dissected them
- *Andropogon* heavier than 0.0016g and *Sorghastrum* heavier than 0.0019g were considered full

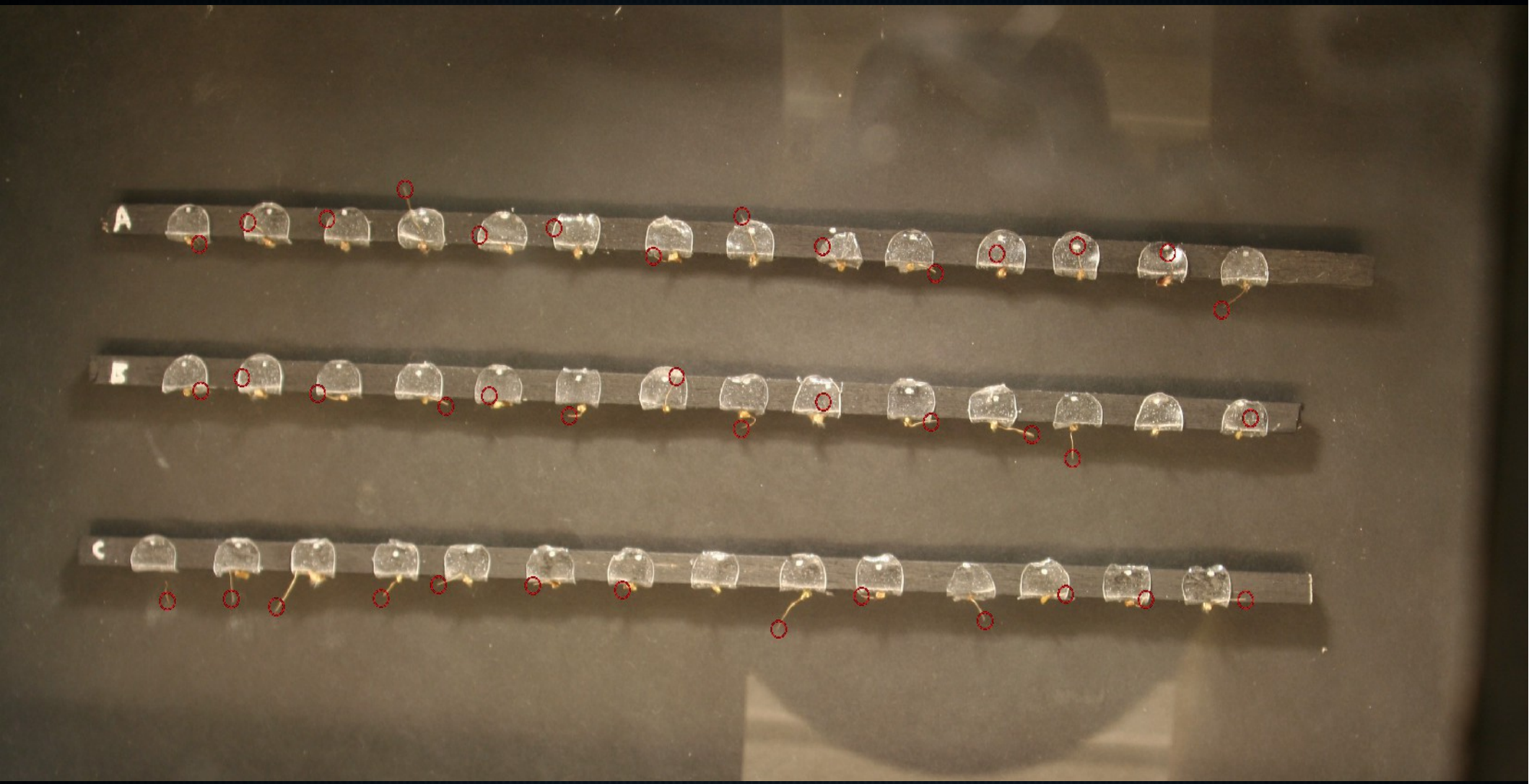

Supplies
ENVIRO 100
COPY
Josh Drizin

Seed placement



Assessing hygroscopic response

https://www.youtube.com/watch?v=BBOWd0SjNG0


A
B
C

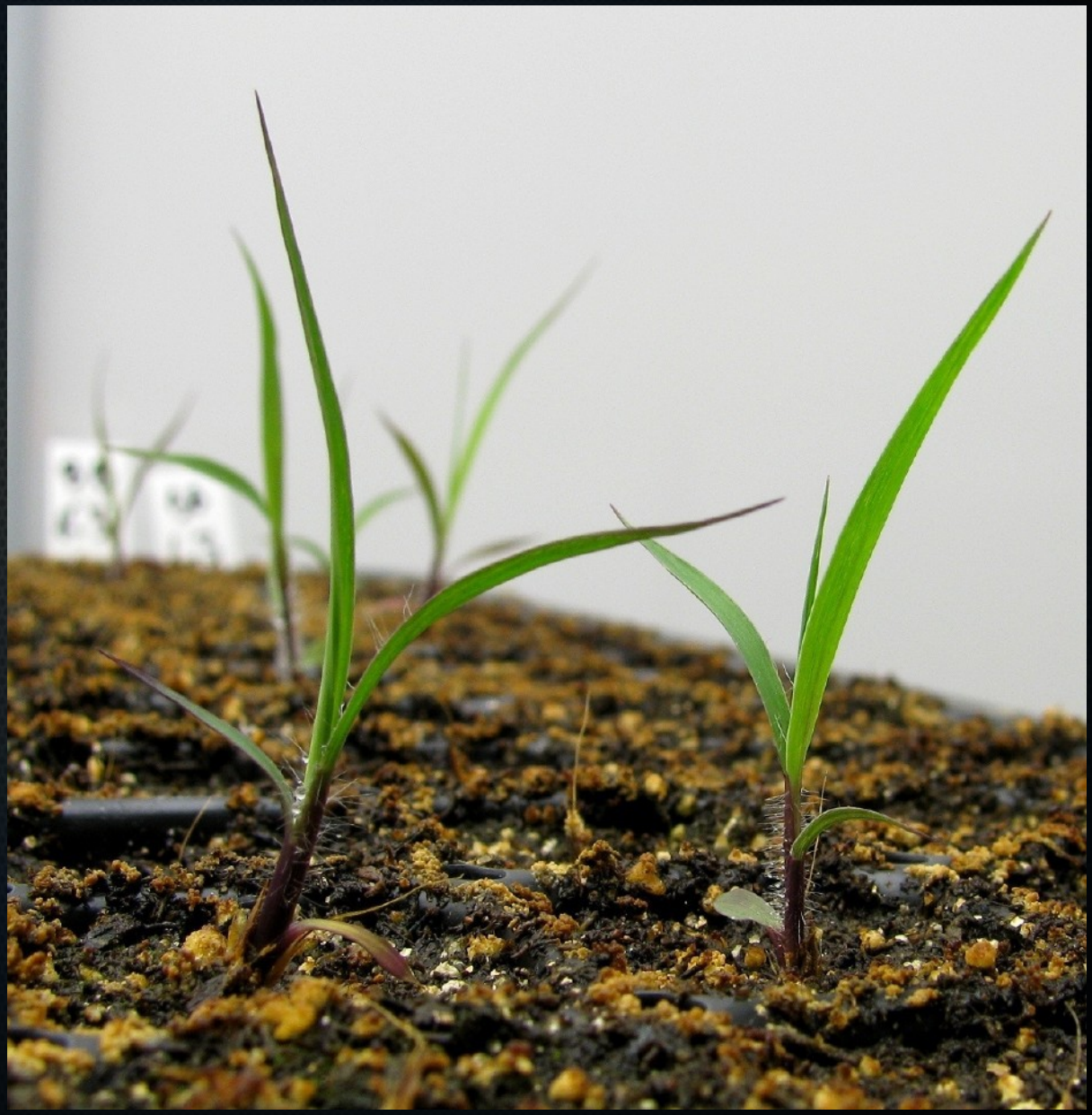
Heritability

Seed material

- Individual lines from Douglas Co, MN
- Later germinated for an offspring cohort

Heritability - Maternal

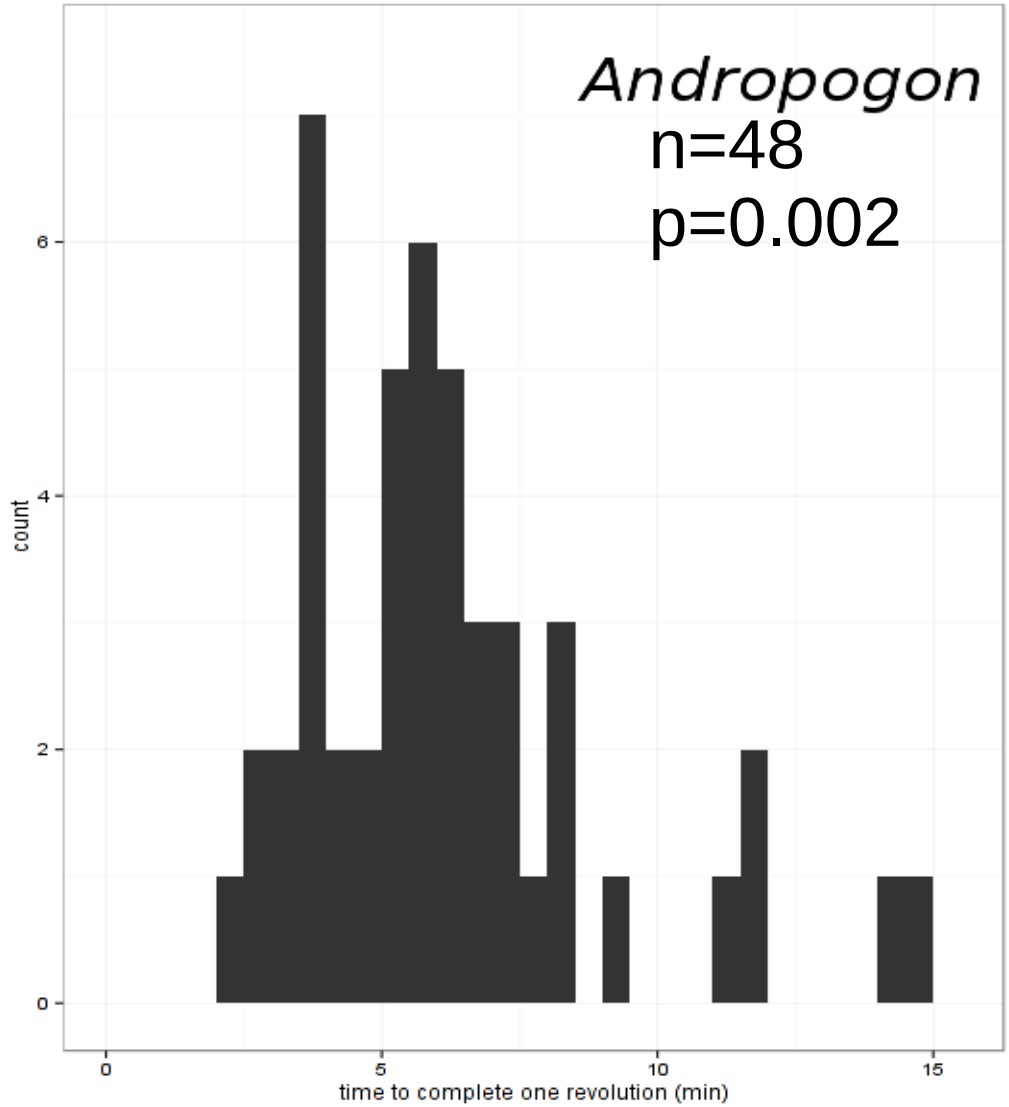
- Maternal seeds chosen for mass
- Spun and photographed
- Germinated and planted out

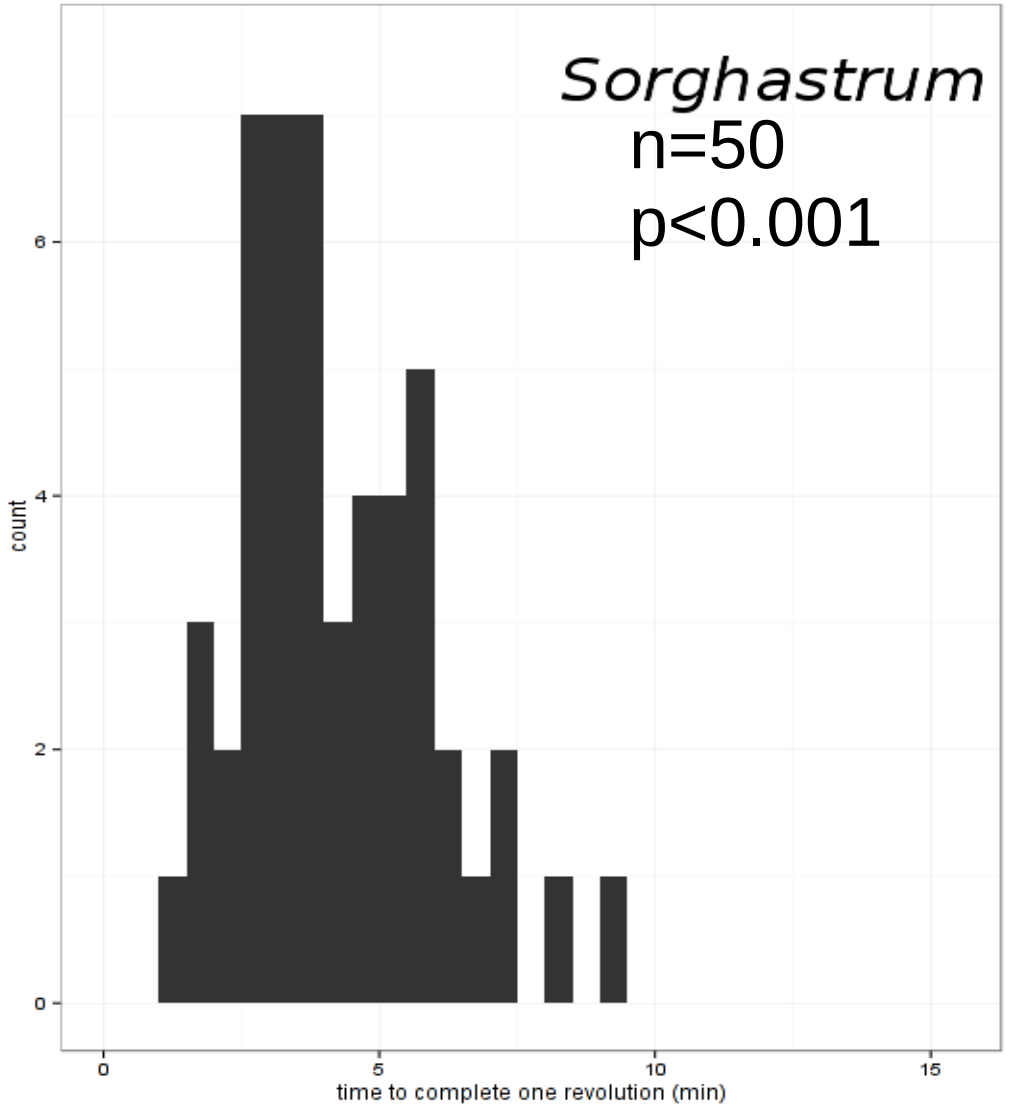


Heritability - Offspring

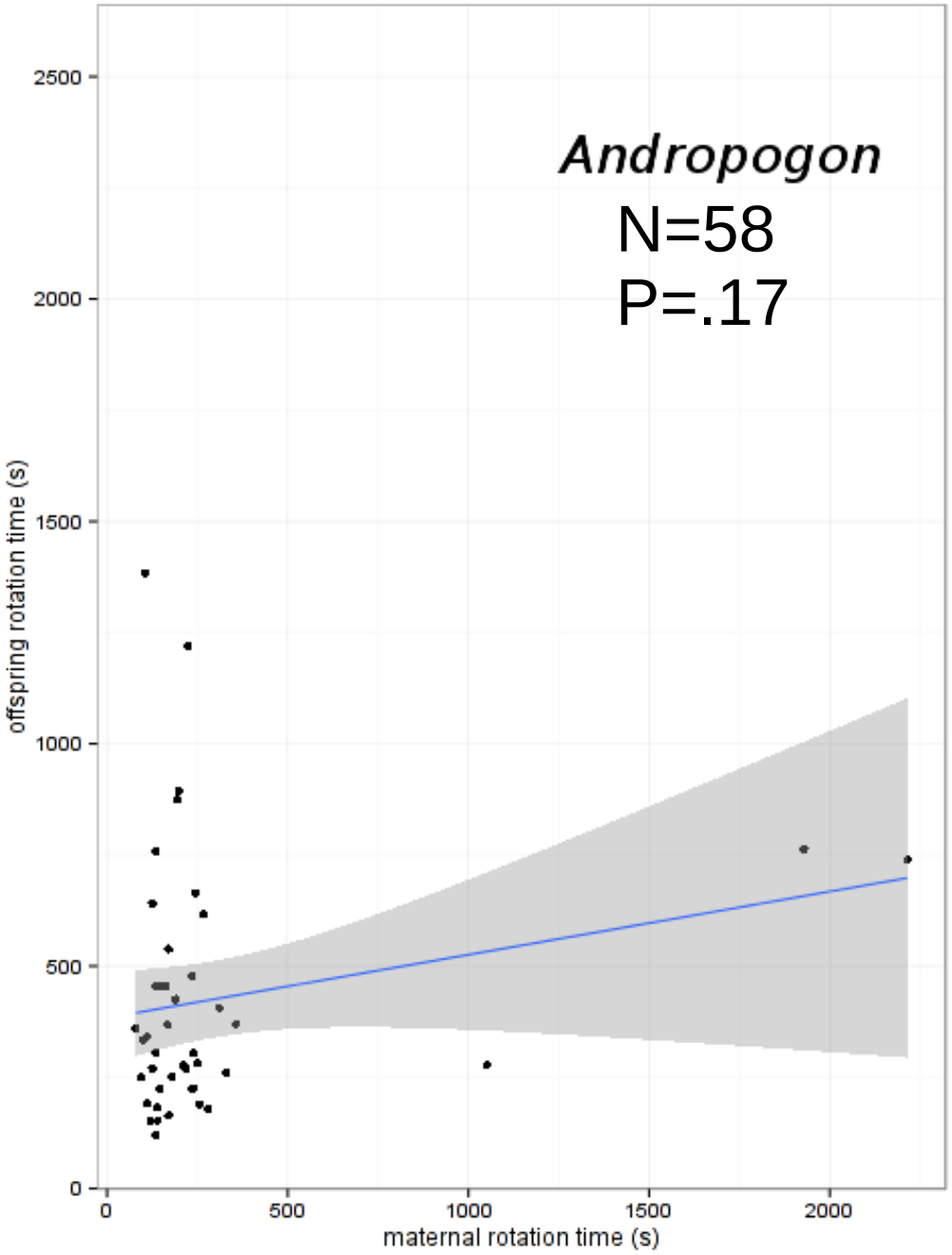
- Planted June 2011
- Watered as needed
- Harvested October 2011
- Estimated heritability

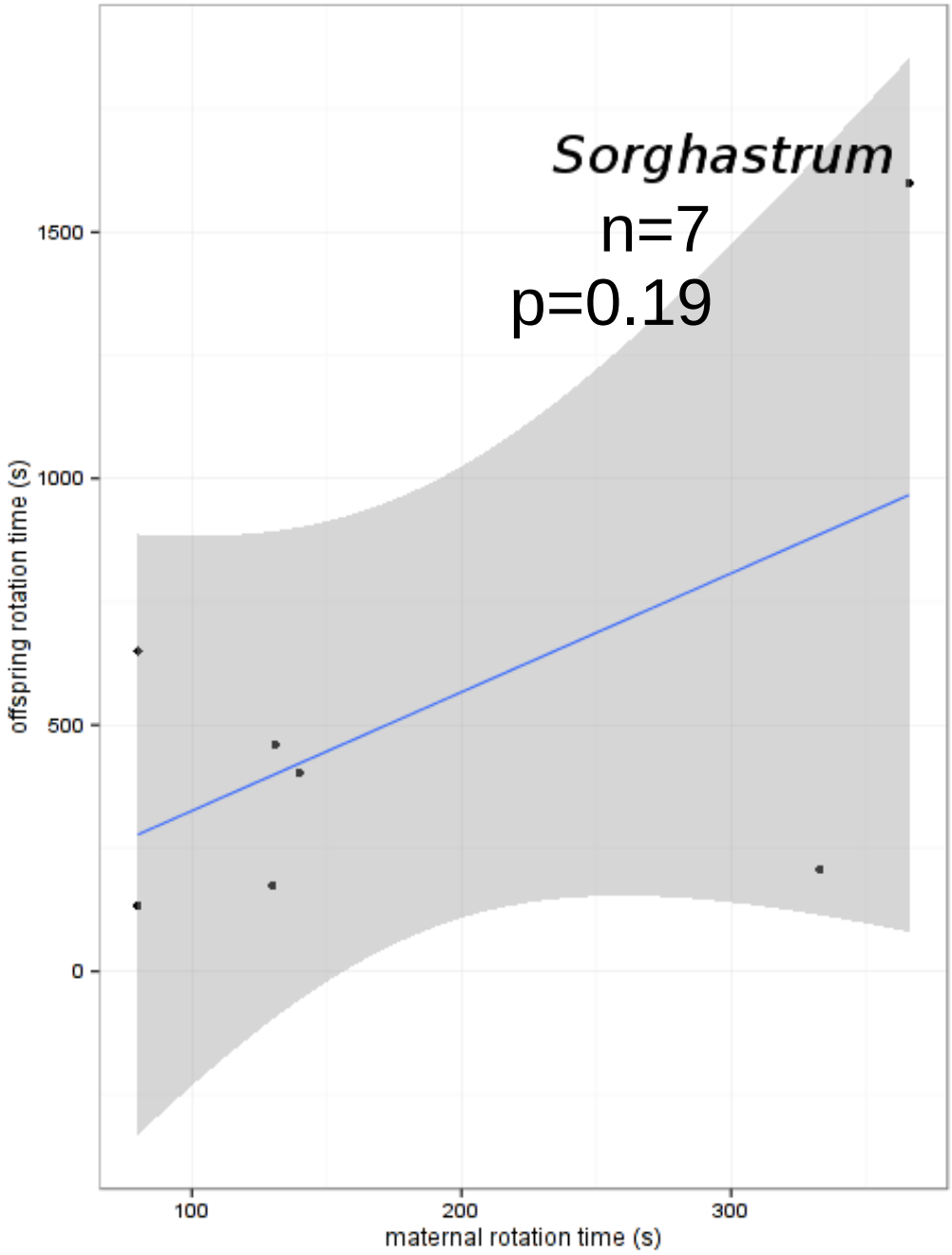
Results – Individual spin times





Heritability





Heritability

- Trait variation
  - Generally 4-6min
  - Ranges from `min to 15min
- Heritability
  - Low sample sizes
  - Suggestive trend in *Andropogon*

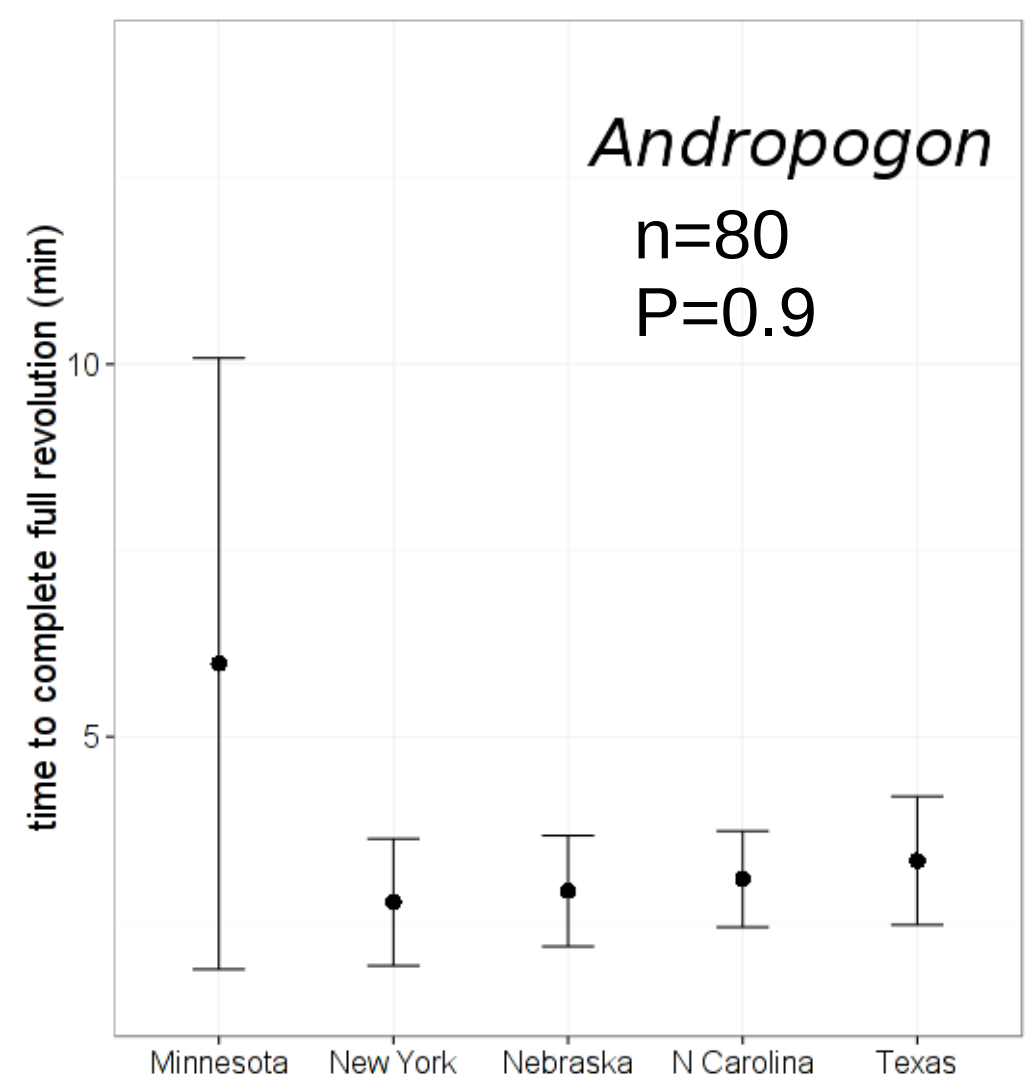
Population differences

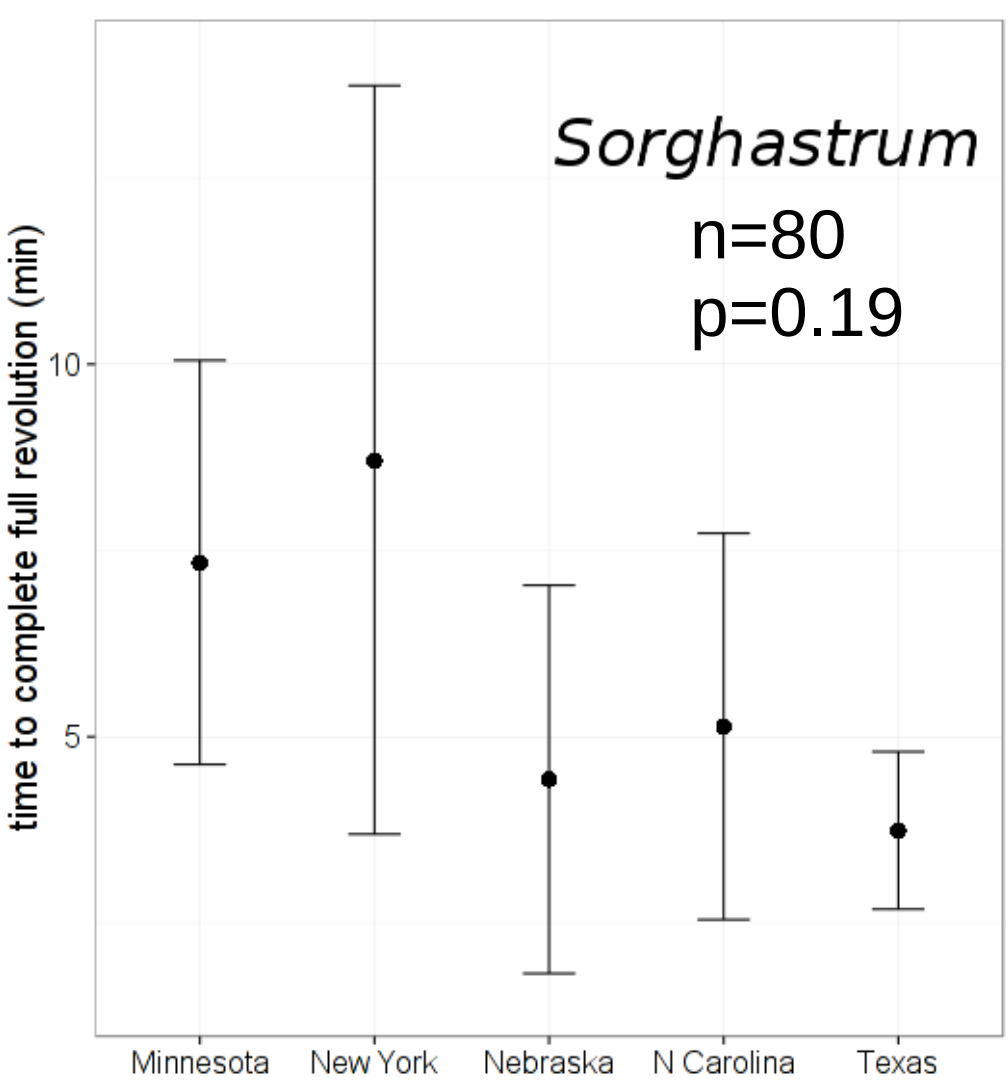
- Assessed hygroscopicity from populations across range
- Seeds acquired from conservation suppliers
- Same photography method

Seed material

- Populations, ground movement
- 5 locations
  - Minnesota
  - New York
  - North Carolina
  - Nebraska
  - Texas

Results – population differences





Different populations

- Differed among *Sorghastrum* but not *Andropogon*
- Northern *Sorghastrum* pops spun more slowly
  - Local adaptation
  - Unintentional selection
- Large differences in variability
- Further experiments

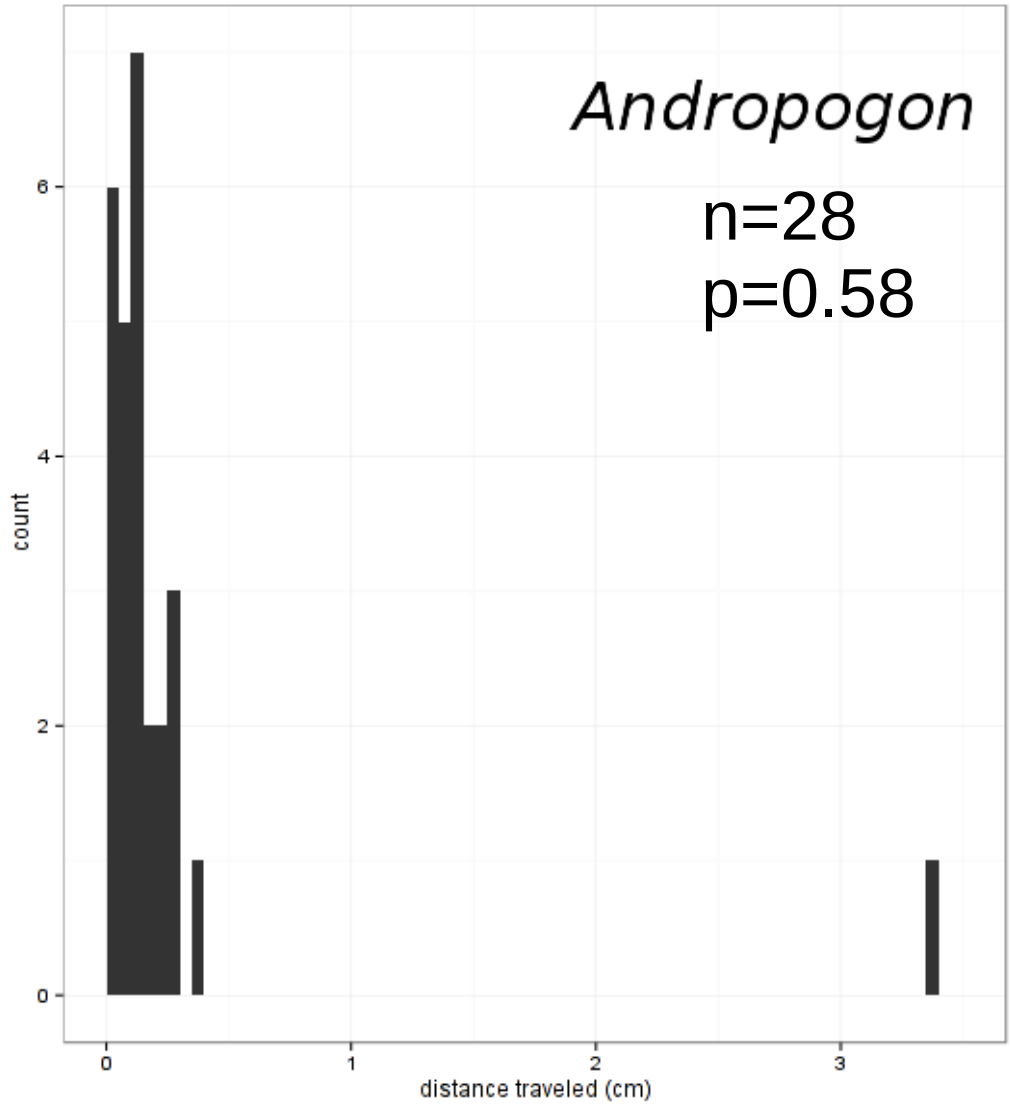
Ground movement

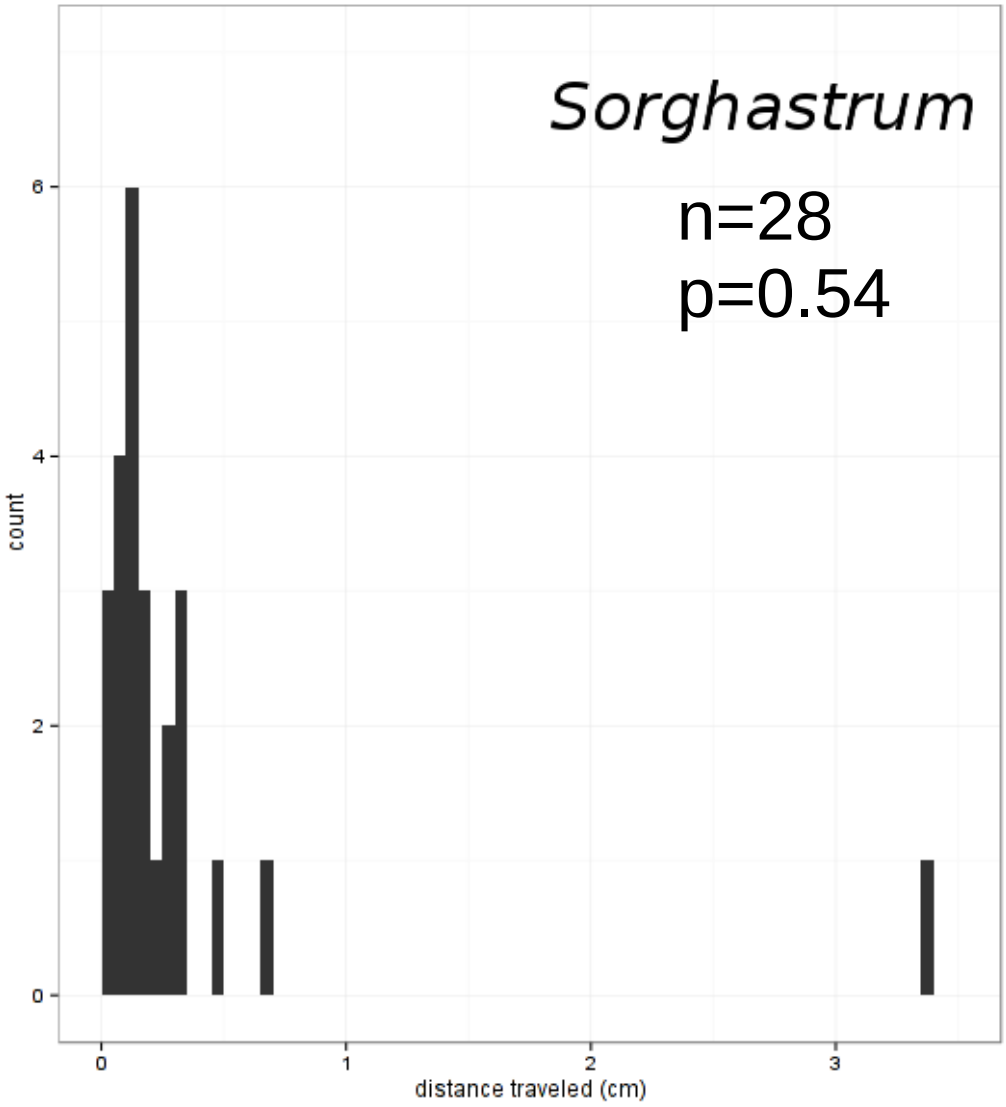
- Used seeds from different populations
- Slightly different photographic method
- Does the awn cause seeds to travel?

Results – ground movement

https://www.youtube.com/watch?v=76i38JuajgM

Results: ground movement





Ground movement

- Did not travel
- Unlike many other species, which do
- Likely fulfils another function

- Making it through duff to the soil?
- Holding the seed to the ground?
  - Absorb moisture better
  - Prevent dessication
  - Brace against emerging radicle
- Seed orientation during dispersal

Overview

- Adaptive traits
  - Exhibit variation
  - Variation must be heritable
  - Some individuals must be more successful
- Variation – yes
- Heritability – maybe
- Movement – uncommon

- Differences among populations
- Potential utility in improving fitness
- Buy local seed

Acknowledgements

- My committee
  - Stuart Wagenius
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- Stock Seed Farms
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