South Dakota State University Extension

Evaluating Planting Methods for Native Seed Production

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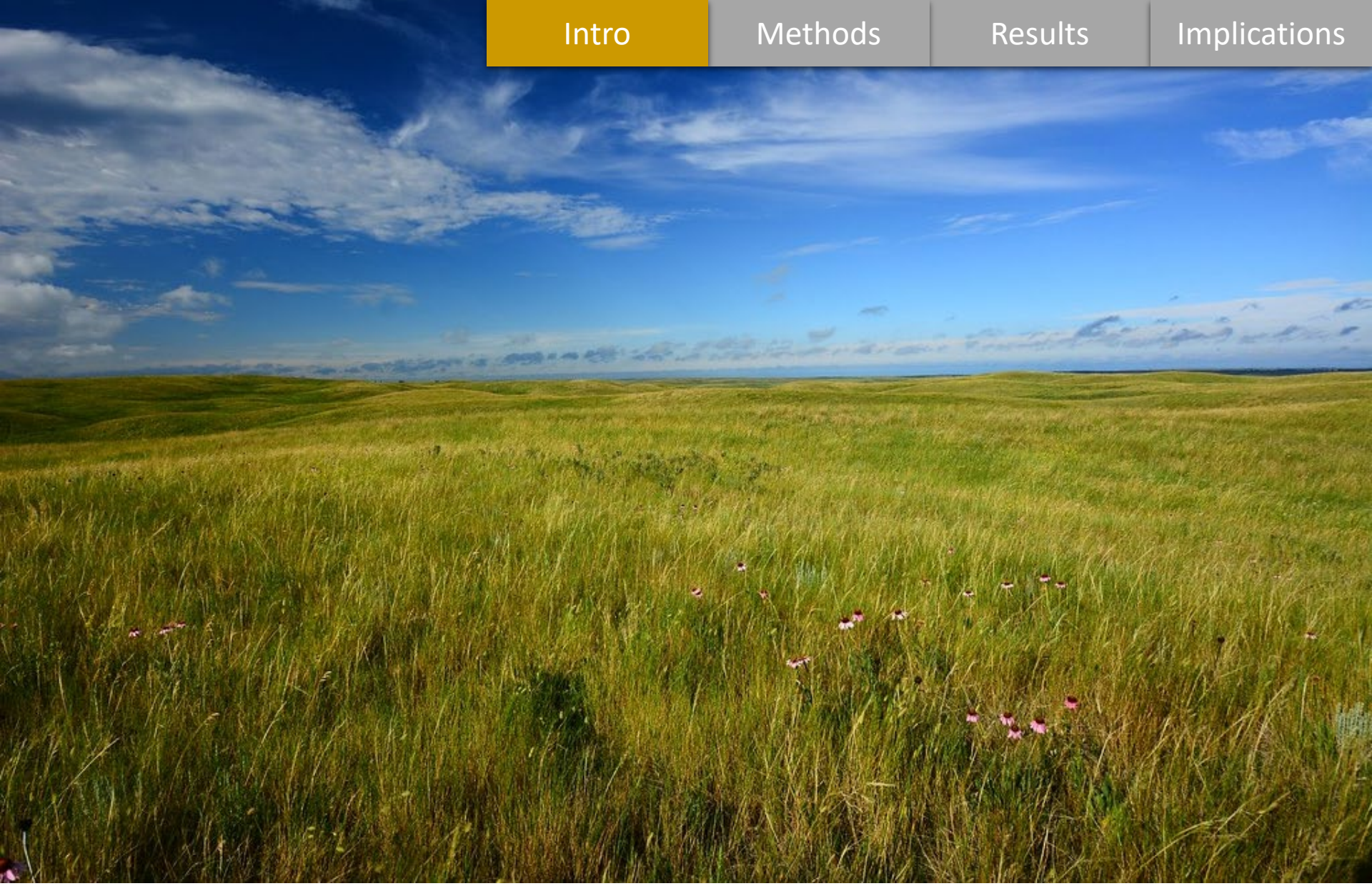
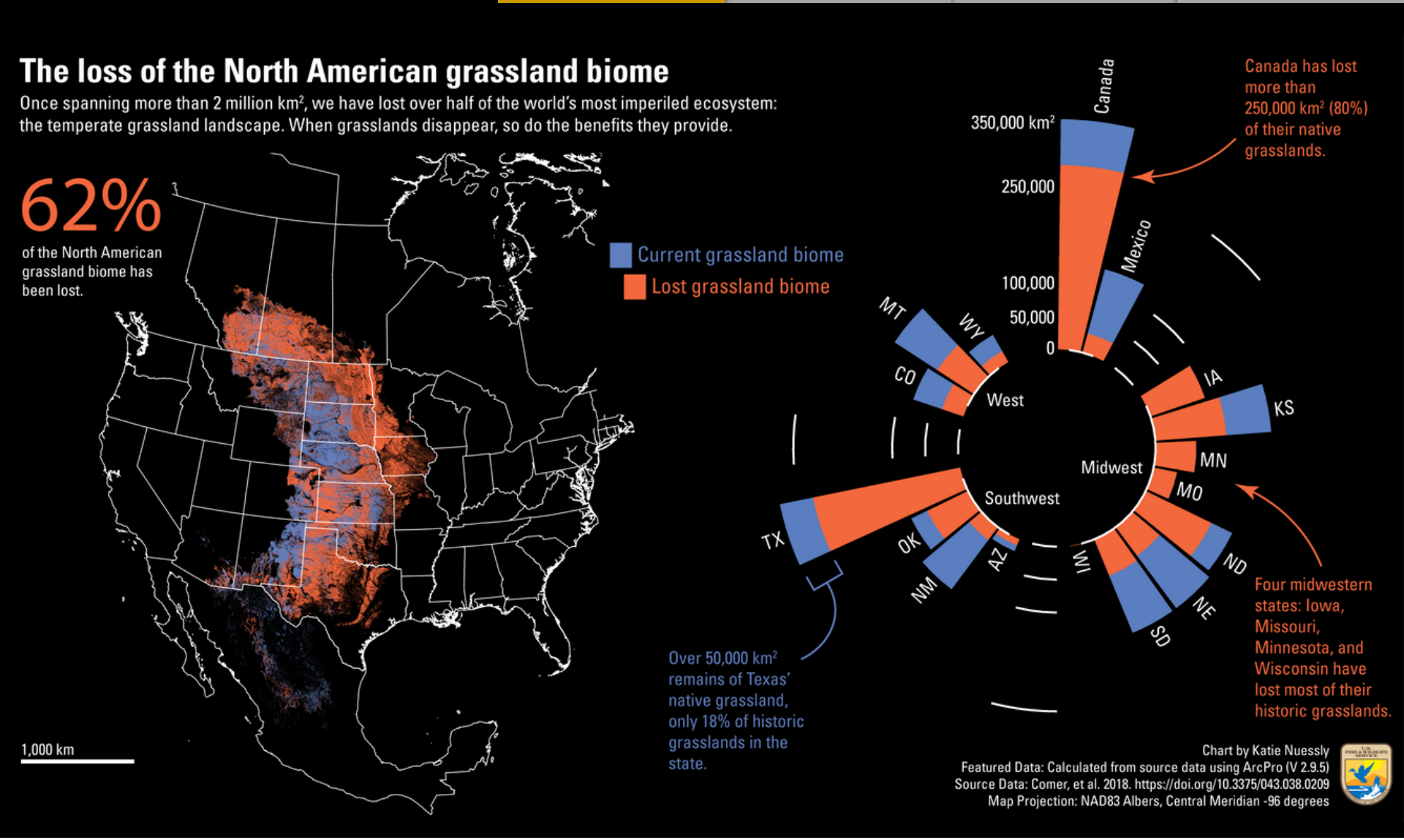
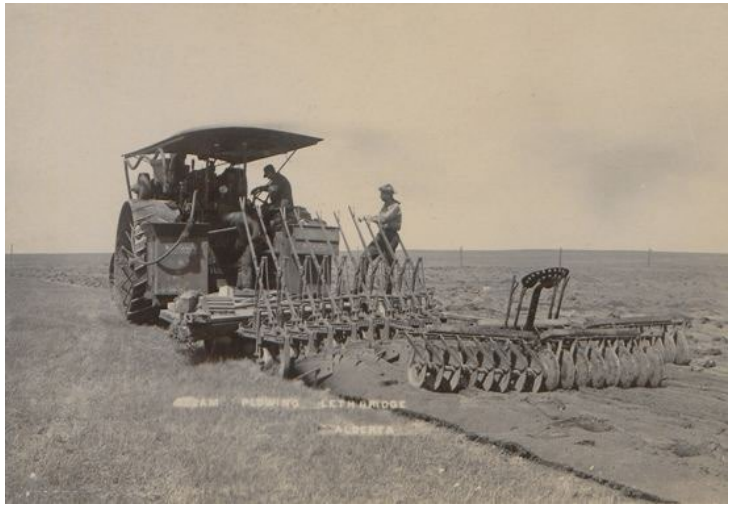



The loss of the North American grassland biome
Once spanning more than 2 million km², we have lost over half of the world's most imperiled ecosystem: the temperate grassland landscape. When grasslands disappear, so do the benefits they provide.
62%
of the North American grassland biome has been lost.
Current grassland biome
Lost grassland biome
1,000 km
Canada
Mexico
350,000 km²
250,000
100,000
50,000
0
Canada has lost more than 250,000 km² (80%) of their native grasslands.
West
Midwest
Southwest
MT
WY
CO
TX
OK
NM
AZ
IA
KS
MN
MO
WI
ND
NE
SD
Over 50,000 km² remains of Texas' native grassland, only 18% of historic grasslands in the state.
Four midwestern states: Iowa, Missouri, Minnesota, and Wisconsin have lost most of their historic grasslands.
Chart by Katie Nuessly
Featured Data: Calculated from source data using ArcPro (V 2.9.5)
Source Data: Comer, et al. 2018. https://doi.org/10.3375/043.038.0209
Map Projection: NAD83 Albers, Central Meridian -96 degrees

Drivers of Loss

- Land use change
- Urbanization
- Agricultural conversion
- Fertile soil in the NGP



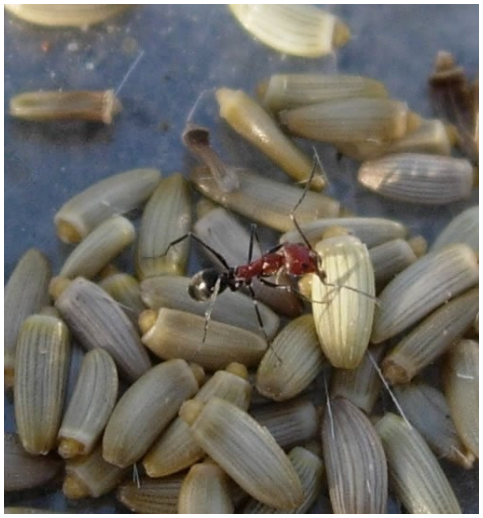
Result of Loss

- Decline in essential ecosystem services
- NGP Services
  - Pollination
  - Seed dispersal
  - Biodiversity
  - Soil formation
  - Water regulation
  - Recreation

Ecological Restoration

- The process of assisting the recovery of a native ecosystem that has been degraded, damaged, or destroyed SER SOCIETY FOR ECOLOGICAL RESTORATION
- Seed-based restoration
- Native seeds required

Barriers to Successful Restoration

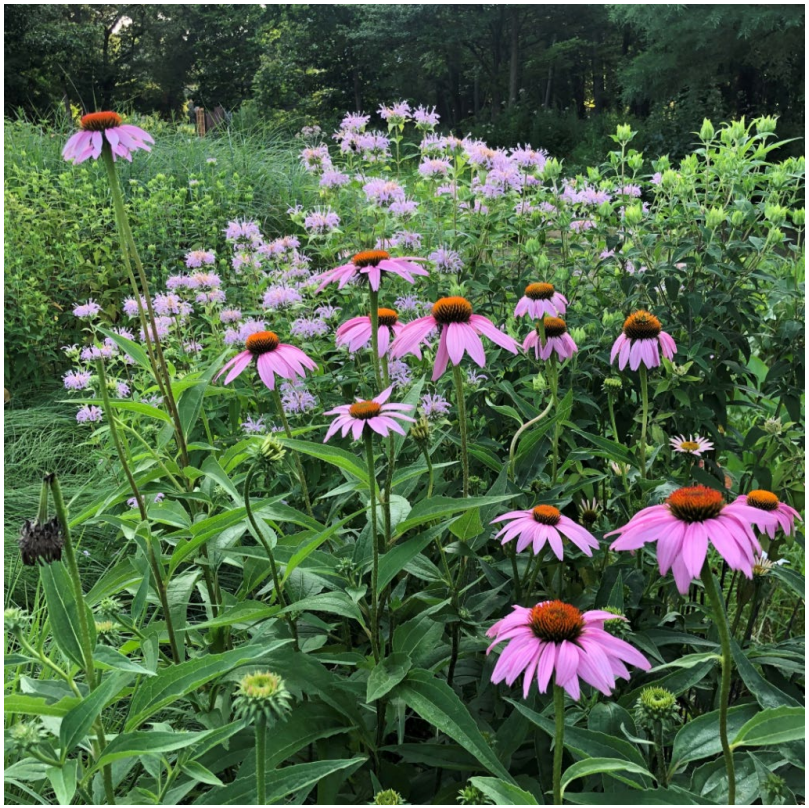


Limited Native Seed

- Shortage of native seeds needed to meet restoration goals
- The United Nations estimates 3.8 trillion pounds of native seed needed for restoring 3.36 billion acres
- Native seed industries are relatively underdeveloped around the world

Impacts

- Decreased restoration capacity
- Limited species selection
- Inappropriate species substitutions
- Overharvesting wild populations



Wild Collection

- Great tool for restoration if done properly
- Risks of wild collection
  - Overharvesting
  - Damaging collection area
  - Invasive/weed contamination
- Wild collection is insufficient for current native seed demand

Native Seed Production

- Multiplies native seed using production methods
- Protocols to ensure genetic variability
- Potential to close the gap in the native seed supply
- Lack of research on using this method in the NGP

Ch. 1: Performance and Cost Comparison of Planting Plugs vs. Seeds in Seven Forb Species Native to the NGP

Objectives

1. Quantify difference in performance of plants established from plugs compared to seeds

2. Calculate cost per present plant and per flowering plant

***H1*:** In plants where plugs outperform seeds in presence probability, plugs will be more cost-effective

***H2*:** Height and reproductive ability will be the same between plants grown from plugs and seeds at the end of the experiment.

Focal Species

Family	Scientific Name	Common Name	Planting Depth (in)	Source
Apocynaceae	*Asclepias tuberosa*	butterfly milkweed	0.25	PP
Fabaceae	*Amorpha canescens*	leadplant	0.19-0.25	SS
Asteraceae	*Echinacea angustifolia*	narrow-leaved coneflower	0.25	PP
	Helianthus maximiliani	Maximilan's sunflower	0.25-0.5	PM
	Liatris aspera	rough blazingstar	0.25	PM
Plantaginaceae	*Penstemon digitalis*	foxglove beardtongue	0.13	PM
Ranunculaceae	*Pulsatilla patens*	Eastern pasqueflower	0.13	PM

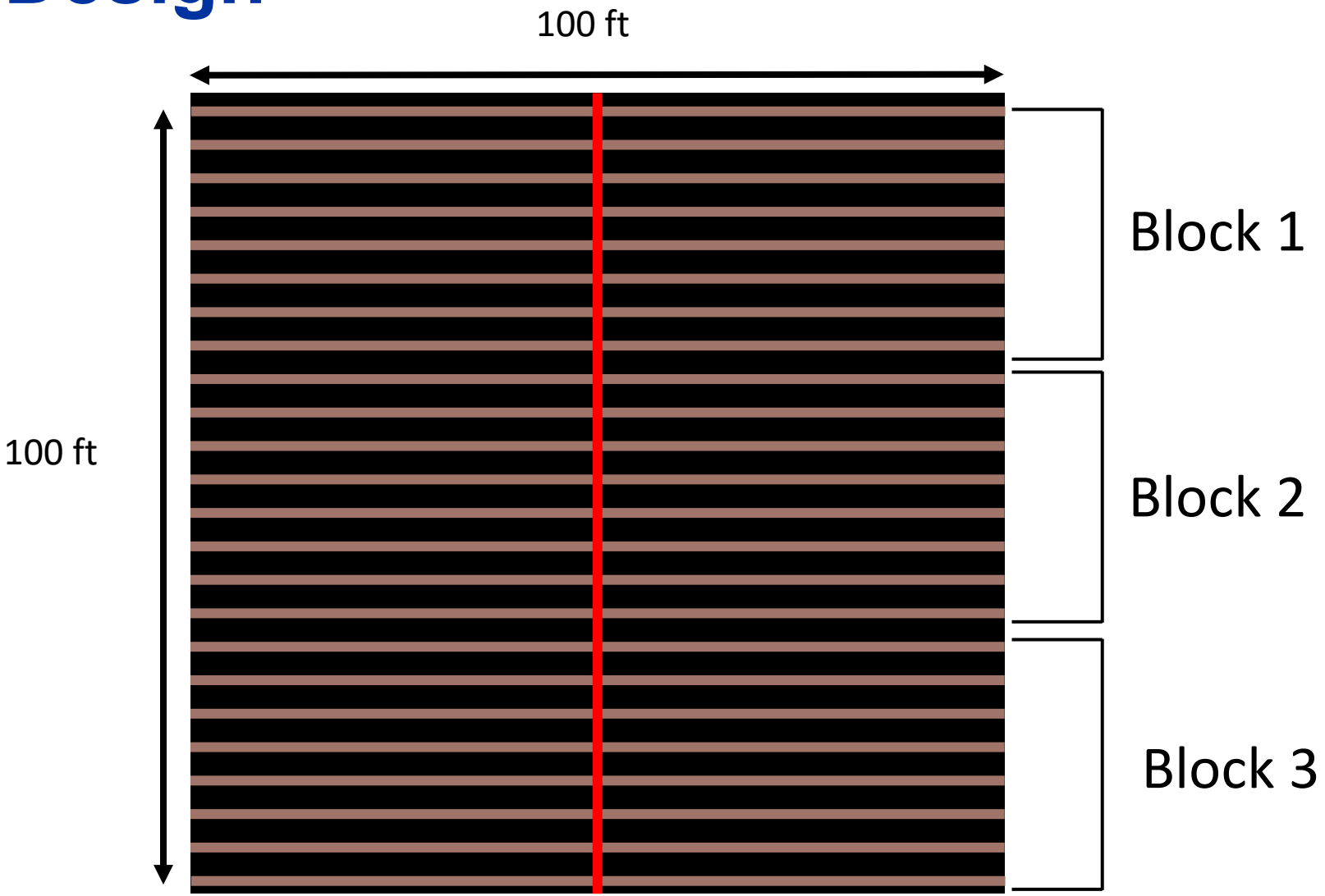
Sowing

- SC4 conetainers
- 114 plugs
- In greenhouse for 92 days
- Fertigated 15 minutes every 2 days

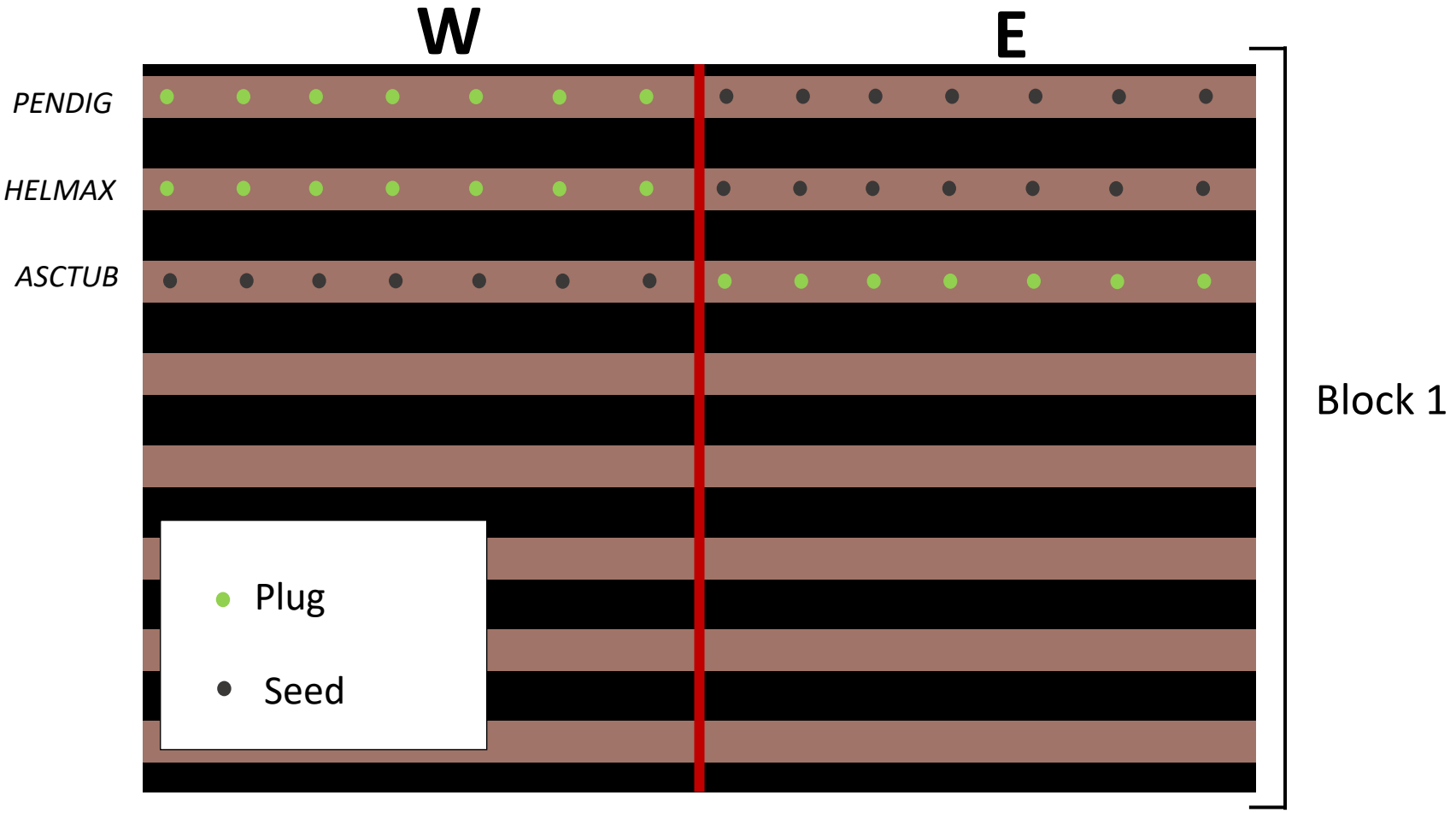
Site

- Common garden plot in Brookings, SD
- Tilled
  - Fall 2023
  - Spring 2024
- Installed weed cloth
  - 3 ft strips
  - Left 1 ft strips of bare soil

Plot Design



Plot Design



Planting & Maintenance

- 114 plugs
- 114 seeds
- 1:1 seed to plug ratio
- Spaced 1 ft apart
- Received same amount of water
- Weeded approx. weekly

Field Data

- Presence
- Height
- Flowering

Cost Analysis Data

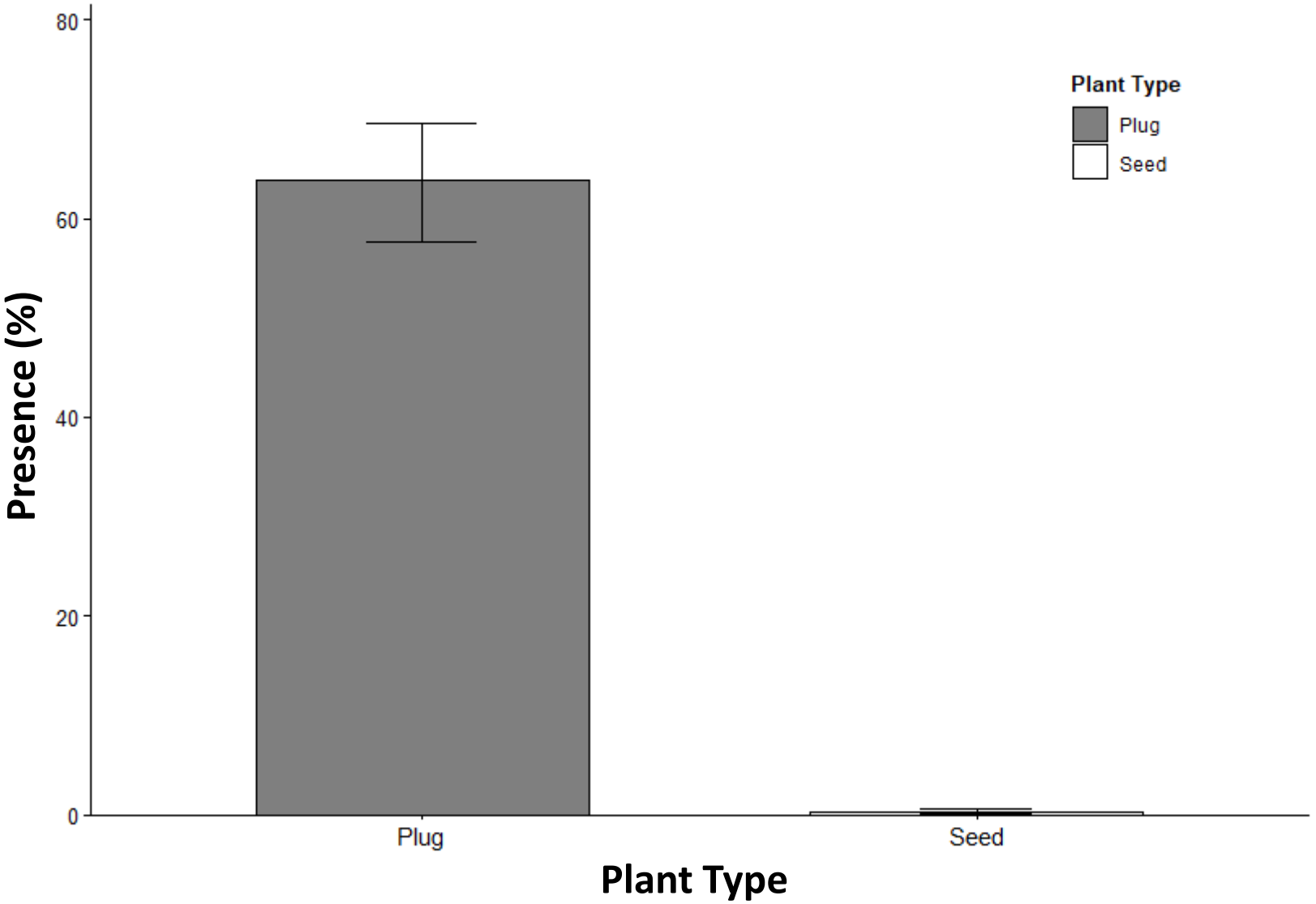
- Obtained prices from 6 producers within 300-mile radius
  - Market-rate seed (price per seed from a smallest quantity available)
  - Market-rate plug
  - Wholesale-rate plug
- Calculated average seed/plug price for each species
- All other initial costs were the same for plugs and seeds

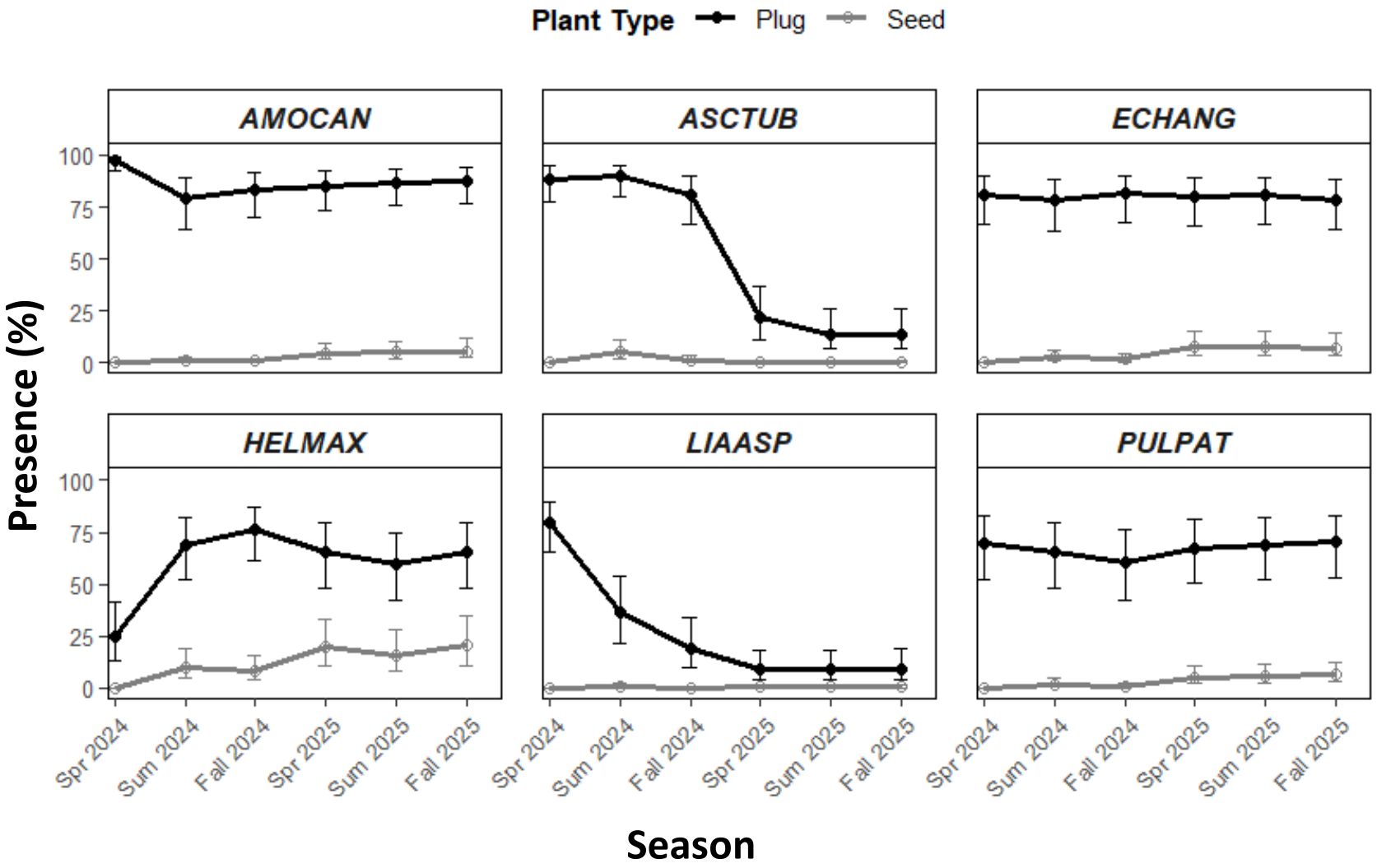
Cost Analysis Equations

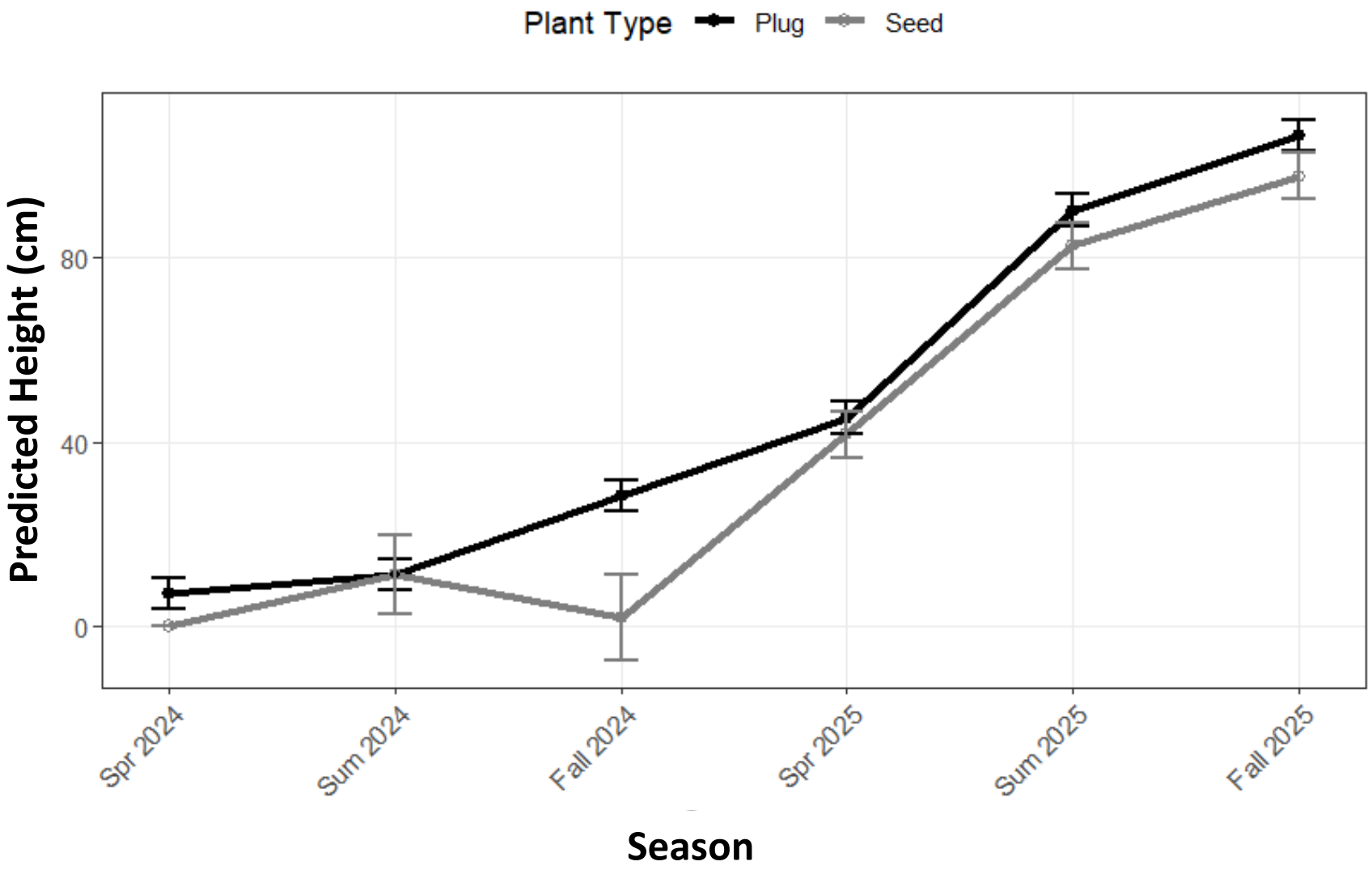
$$C_e = C_s / p_e \text{ and } C_e = C_p / p_e$$

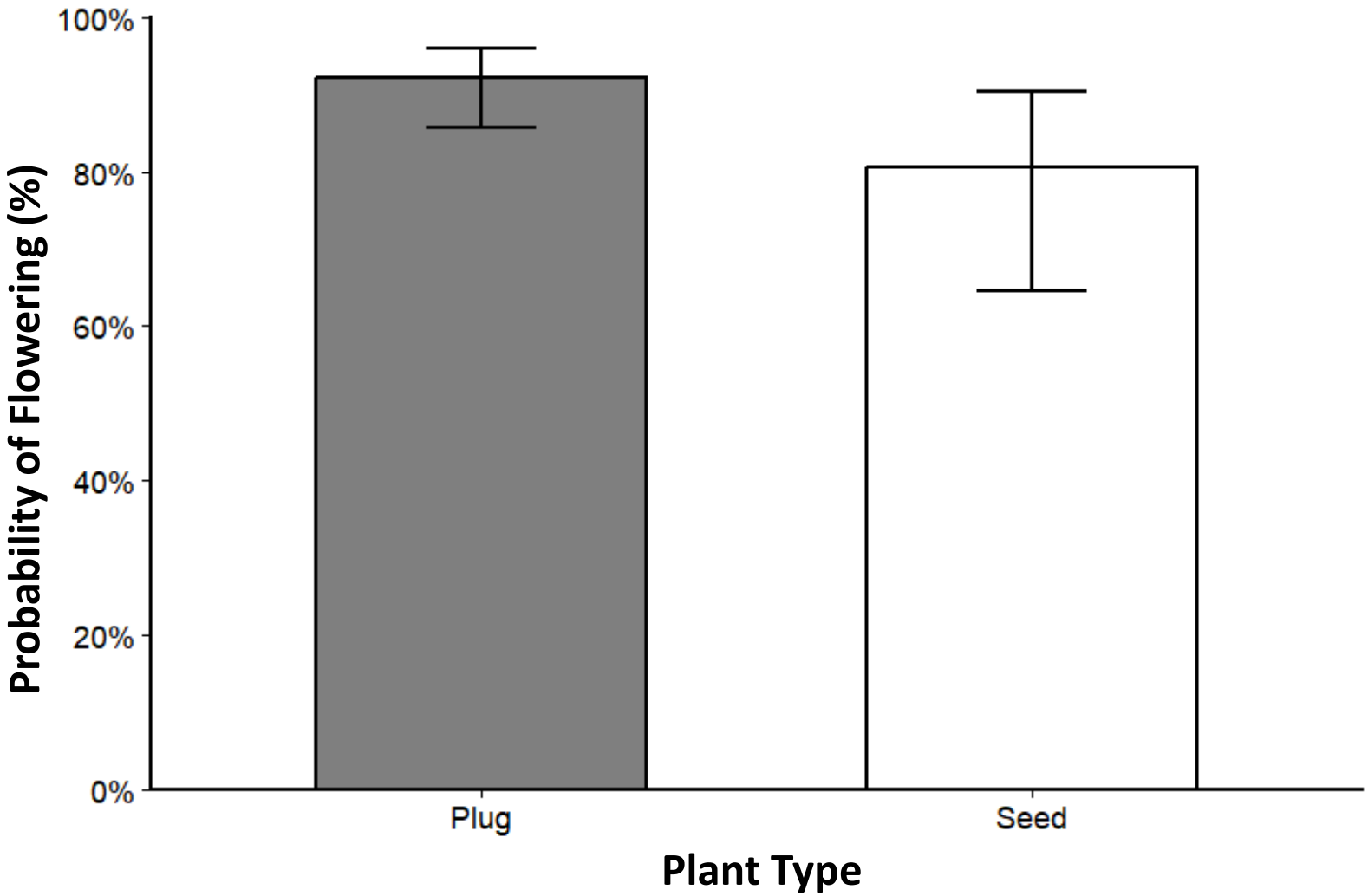
$$C_f = C_e / p_f$$

C_e – *cost per present plant*
C_f – *cost per flowering plant*
C_s – *average cost per seed*
C_p – *average cost per plug*
p_e – *probability of presence*
p_f – *probability of flowering*


Presence (%)
80
60
40
20
0
Plug
Seed
Plant Type
Plug
Seed
Plant Type


Plant Type
Plug
Seed
AMOCAN
ASCTUB
ECHANG
HELMAX
LIAASP
PULPAT
Presence (%)
100
75
50
25
0
Spr 2024
Sum 2024
Fall 2024
Spr 2025
Sum 2025
Fall 2025
Season


Plant Type
Plug
Seed
Predicted Height (cm)
80
40
0
Spr 2024
Sum 2024
Fall 2024
Spr 2025
Sum 2025
Fall 2025
Season


100%
80%
60%
40%
20%
0%
Probability of Flowering (%)
Plug
Seed
Plant Type

Summary

- Presence
  - Plugs outperformed seeds
- Height
  - Plugs had a greater average height
- Reproductive ability
  - Plugs had more flowering stems

Summary

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  - Plugs outperformed seeds
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- Reproductive ability
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Negligible in field

Species	Plant Type	Average Cost ($)
A. canescens	Seed	0.0179
	Market Plug	5.92
	Wholesale Plug	2.06
E. angustifolia	Seed	0.0291
	Market Plug	5.58
	Wholesale Plug	2.06
H. maximiliani	Seed	0.0087
	Market Plug	4.88
	Wholesale Plug	2.04
L. aspera	Seed	0.0331
	Market Plug	5.92
	Wholesale Plug	2.06
P. patens	Seed	0.0350
	Market Plug	6.50
	Wholesale Plug	2.04

Species	Plant Type	Average Cost ($)	Probability of Presence
A. canescens	Seed	0.0179	0.096
	Market Plug	5.92	0.816
	Wholesale Plug	2.06	0.816
E. angustifolia	Seed	0.0291	0.132
	Market Plug	5.58	0.719
	Wholesale Plug	2.06	0.719
H. maximiliani	Seed	0.0087	0.263
	Market Plug	4.88	0.623
	Wholesale Plug	2.04	0.623
L. aspera	Seed	0.0331	0.018
	Market Plug	5.92	0.140
	Wholesale Plug	2.06	0.140
P. patens	Seed	0.0350	0.132
	Market Plug	6.50	0.632
	Wholesale Plug	2.04	0.632

Species	Plant Type	Average Cost ($)	Probability of Presence	Cost ($) / Present Plant
A. canescens	Seed	0.0179	0.096	0.19
	Market Plug	5.92	0.816	7.25
	Wholesale Plug	2.06	0.816	2.52
E. angustifolia	Seed	0.0291	0.132	0.22
	Market Plug	5.58	0.719	7.76
	Wholesale Plug	2.06	0.719	2.87
H. maximiliani	Seed	0.0087	0.263	0.03
	Market Plug	4.88	0.623	7.83
	Wholesale Plug	2.04	0.623	3.27
L. aspera	Seed	0.0331	0.018	1.84
	Market Plug	5.92	0.140	42.29
	Wholesale Plug	2.06	0.140	14.71
P. patens	Seed	0.0350	0.132	0.27
	Market Plug	6.50	0.632	10.28
	Wholesale Plug	2.04	0.632	3.23

Species	Plant Type	Average Cost ($)	Probability of Presence	Cost ($) / Present Plant
A. canescens	Seed	0.0179	0.096	0.19
	Market Plug	5.92	0.816	7.25
	Wholesale Plug	2.06	0.816	2.52
E. angustifolia	Seed	0.0291	0.132	0.22
	Market Plug	5.58	0.719	7.76
	Wholesale Plug	2.06	0.719	2.87
H. maximiliani	Seed	0.0087	0.263	0.03
	Market Plug	4.88	0.623	7.83
	Wholesale Plug	2.04	0.623	3.27
L. aspera	Seed	0.0331	0.018	1.84
	Market Plug	5.92	0.140	42.29
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P. patens	Seed	0.0350	0.132	0.27
	Market Plug	6.50	0.632	10.28
	Wholesale Plug	2.04	0.632	3.23

Species	Plant Type	Average Cost ($)	Probability of Presence	Cost ($) / Present Plant	Probability of Flowering
A. canescens	Seed	0.0179	0.096	0.19	0.818
	Market Plug	5.92	0.816	7.25	0.839
	Wholesale Plug	2.06	0.816	2.52	0.839
E. angustifolia	Seed	0.0291	0.132	0.22	0.8
	Market Plug	5.58	0.719	7.76	0.939
	Wholesale Plug	2.06	0.719	2.87	0.939
H. maximiliani	Seed	0.0087	0.263	0.03	0.833
	Market Plug	4.88	0.623	7.83	1
	Wholesale Plug	2.04	0.623	3.27	1
L. aspera	Seed	0.0331	0.018	1.84	1
	Market Plug	5.92	0.140	42.29	0.938
	Wholesale Plug	2.06	0.140	14.71	0.938
P. patens	Seed	0.0350	0.132	0.27	0.533
	Market Plug	6.50	0.632	10.28	0.819
	Wholesale Plug	2.04	0.632	3.23	0.819

Species	Plant Type	Average Cost ($)	Presence Probability	Probability of Flowering	Cost ($) / Present Plant	Cost ($) / Flowering Plant
A. canescens	Seed	0.0179	0.096	0.818	0.19	0.23
	Market Plug	5.92	0.816	0.839	7.25	8.64
	Wholesale Plug	2.06	0.816	0.839	2.52	3.00
E. angustifolia	Seed	0.0291	0.132	0.8	0.22	0.28
	Market Plug	5.58	0.719	0.939	7.76	8.26
	Wholesale Plug	2.06	0.719	0.939	2.87	3.06
H. maximiliani	Seed	0.0087	0.263	0.833	0.03	0.04
	Market Plug	4.88	0.623	1	7.83	7.83
	Wholesale Plug	2.04	0.623	1	3.27	3.27
L. aspera	Seed	0.0331	0.018	1	1.84	1.84
	Market Plug	5.92	0.140	0.938	42.29	45.09
	Wholesale Plug	2.06	0.140	0.938	14.71	15.68
P. patens	Seed	0.0350	0.132	0.533	0.27	0.51
	Market Plug	6.50	0.632	0.819	10.28	12.55
	Wholesale Plug	2.04	0.632	0.819	3.23	3.94

Cost Considerations

- Planting seeds was more cost-effective in 5 of 7 species
- If resources allow, seed producers should start plugs from seeds themselves
- *P. digitalis* had the highest raw presence from plugs but was excluded from analyses

Further Research

- Cost and performance comparisons in other species native to the NGP
- Capture long-term differences in performance

Acknowledgements

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Questions

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