



# “Below the Scenes”

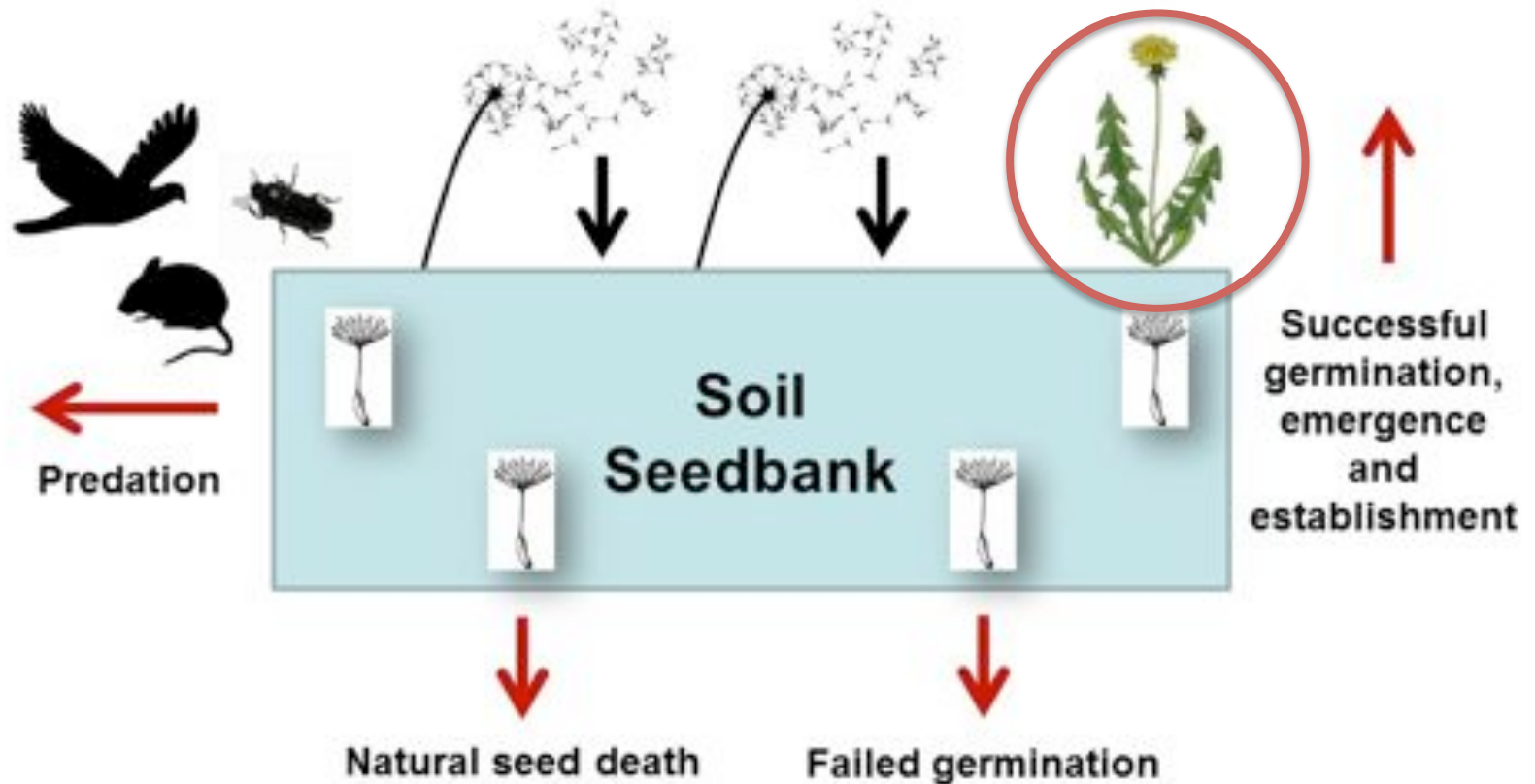
A soil weed seedbank case study

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# What is a “seedbank”?

- Un-germinated weed seeds belowground
- Deposits and withdrawals
- May or may not actually germinate
- Filters dictate what emerges
  - Primary tillage, weed control, planting timing, fertility
  - Tilling brings up seeds
  - Forage crops outcompete emerging weeds

# The Seedbank Cycle



# Why do this study?

- Farmers observe aboveground weeds
- Farmers noticing red clover
  - Is there a persistent red clover seedbank?
- We wanted to know:
  - The range of seedbank densities across farms
  - How does the weed community vary within and among farms?

# Collection Methods

- 4 farms in Seneca/Yates/Tompkins
- Farmers chose 3 fields
- Sampling in March/April, 2015/2016
- Fields divided into 4 quadrants
  - 30 cores per quad
- 8-in depth, 5/8<sup>th</sup> in diameter
- Also collected:
  - Bulk density
  - Gravimetric water content
  - Soil health
  - Field management history



# Farmers identified 3 fields each:

1. Weedy

2. Clean

3. High-clover



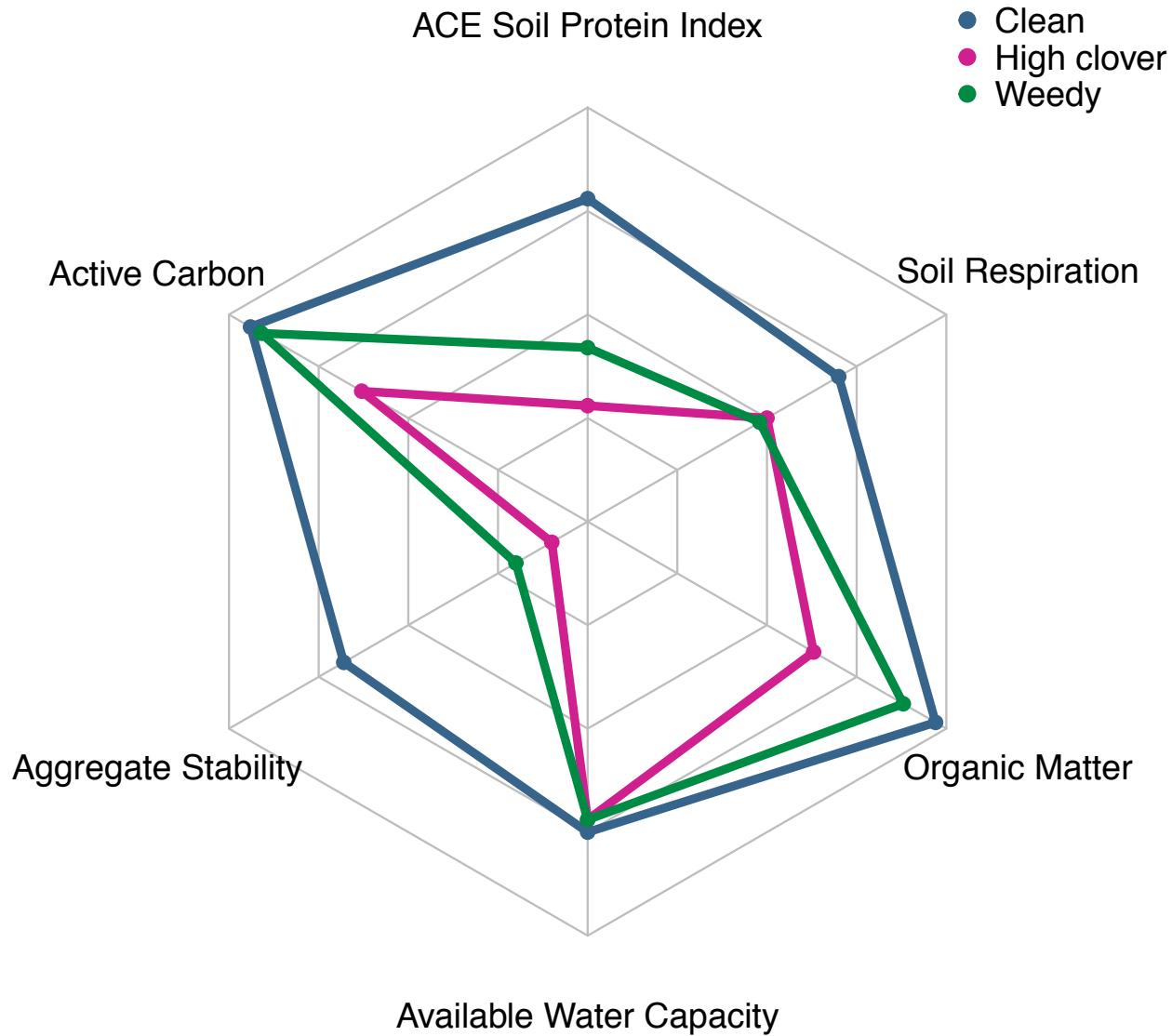


# Soil Health

- Cornell Soil Health lab
- Organic matter, aggregate stability, soil respiration, active carbon, soil protein
- Goal is “characterization”, not cause & effect



# Farm #3

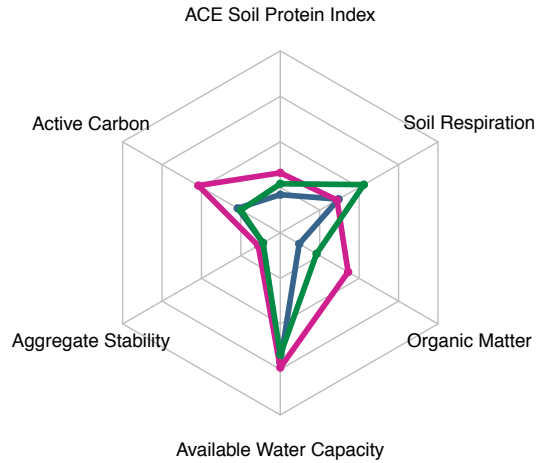




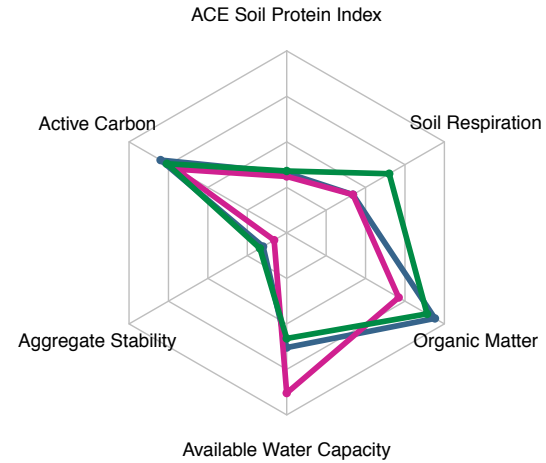
# On-Farm Weed Seedbank Project

## Soil Health Indicator Ratings 2016

### Farm #1

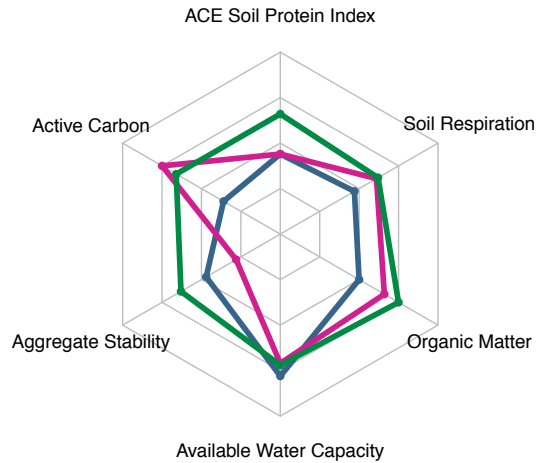


### Farm #2

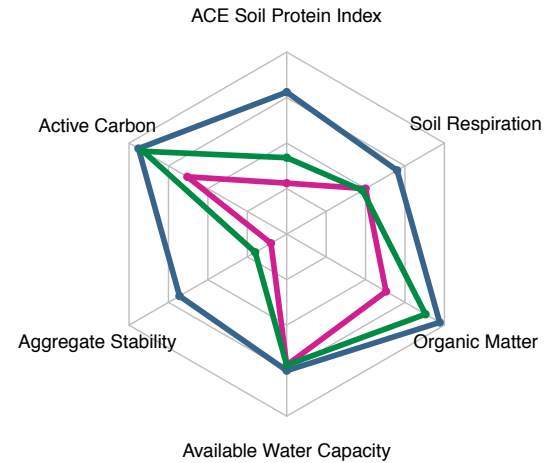


● Clean ● High clover ● Weedy

### Farm #3



### Farm #4



# Greenhouse bioassay



Trays of soil from field quadrants



See who grows up in them!

# Greenhouse Methods

- 1 kg soil from each quadrant in a 10x10-in flat
- Vermiculite, watered daily
- Weeds counted and removed
- 2 “flushes”: soil dried and mixed once more





# Identifying in the greenhouse....



81 unique species in 2015, 77 in 2016



# Results: Red clover



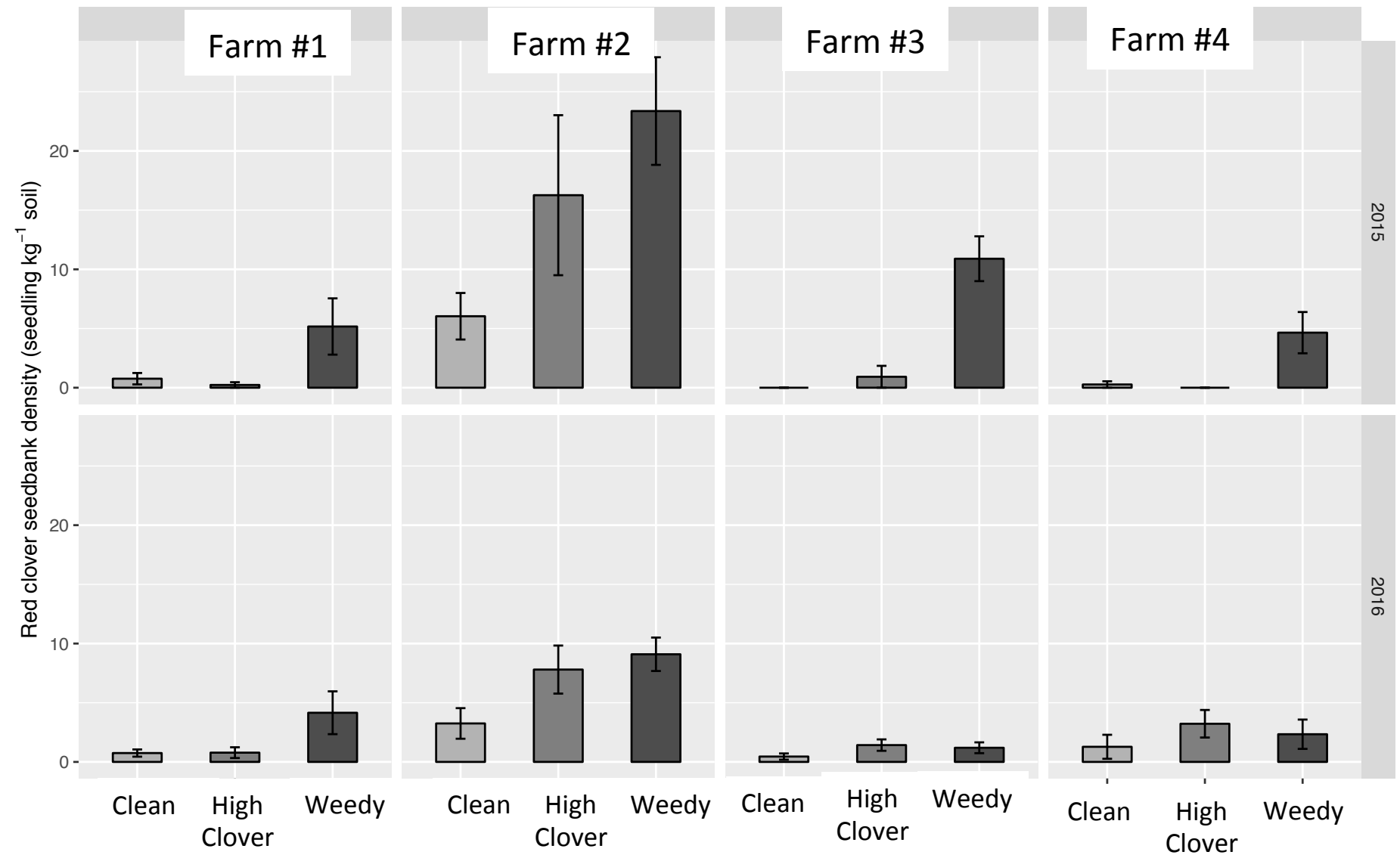
# Red clover

- 6<sup>th</sup> most common species in 2015, 9<sup>th</sup> in 2016
- 5% of all seedlings in 2015, 4% in 2016
- Farm #2 = highest red clover populations
  - Organic management for 30 years
  - Occasionally harvest red clover for seed
- Red clover seedlings/kg soil (across all 12 fields)
  - 2015: up to 23
  - 2016: up to 9
- “Weedy” fields actually had more clover than “high clover” fields





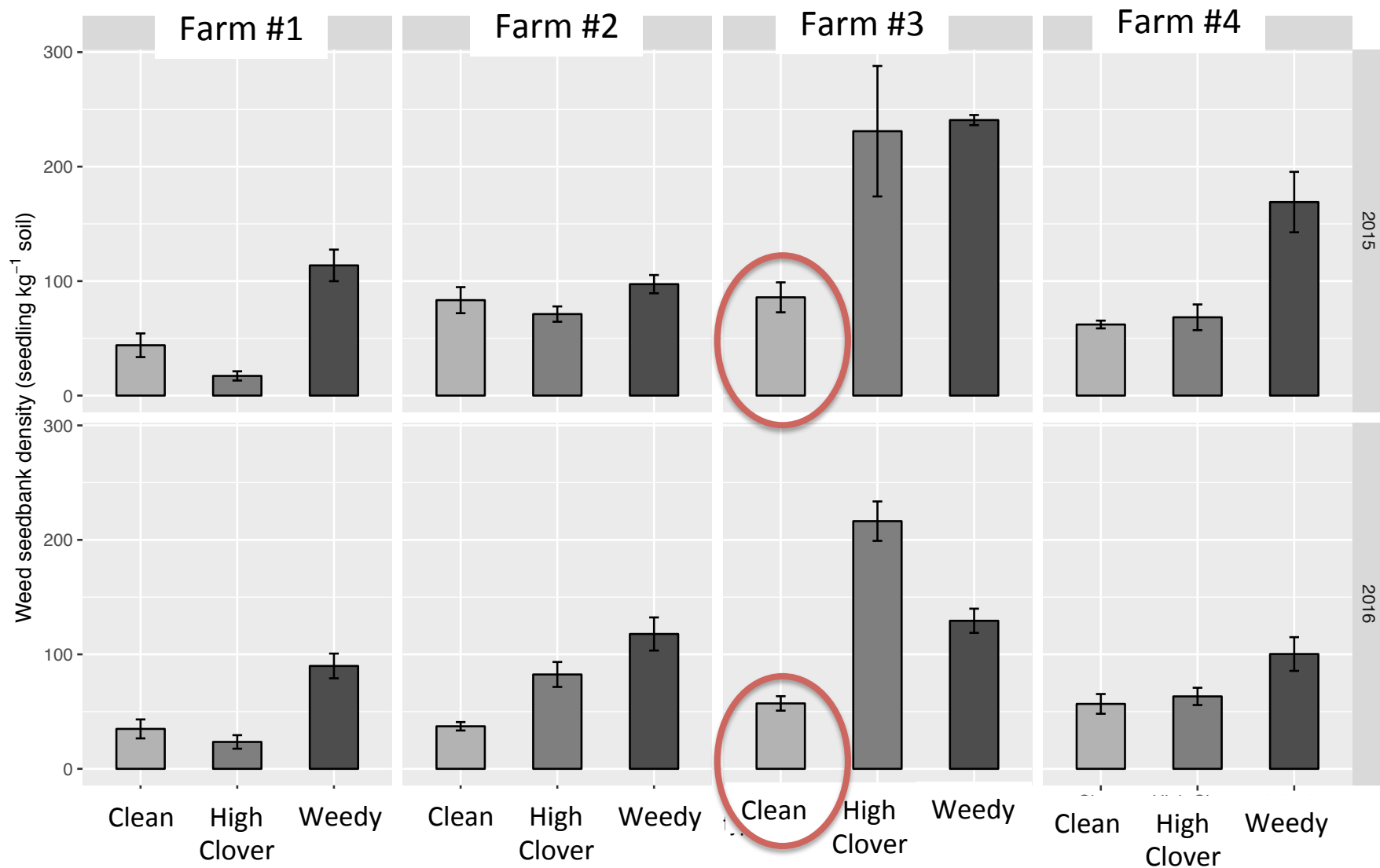
# Red Clover



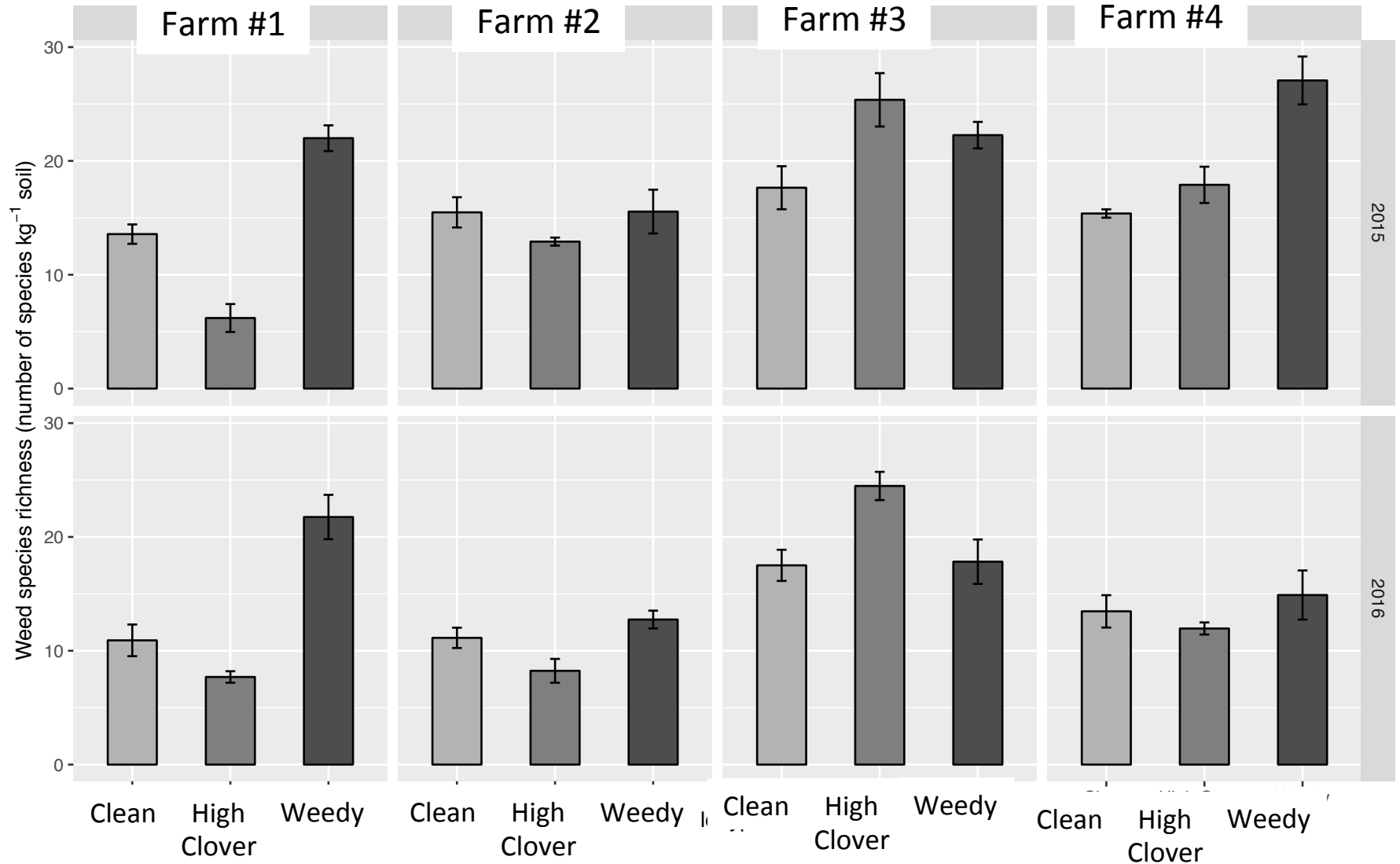
# Results: Weeds



# Weed density



# Number of weed species



# The species

- Who are they?
- How competitive are they?
- Who is dominant?



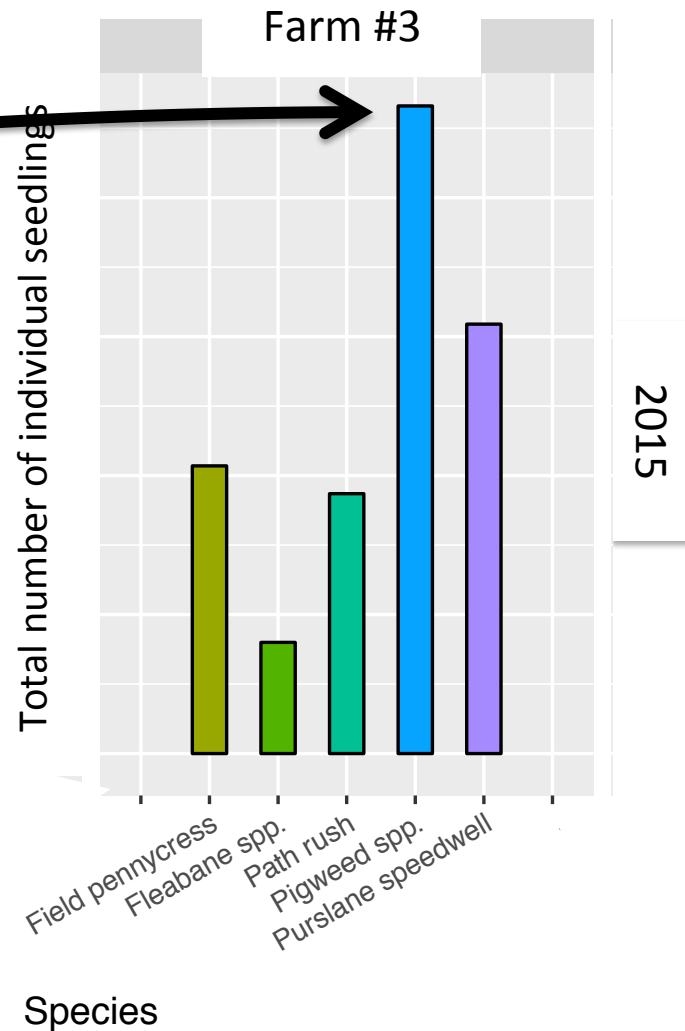
# Most Common Weeds

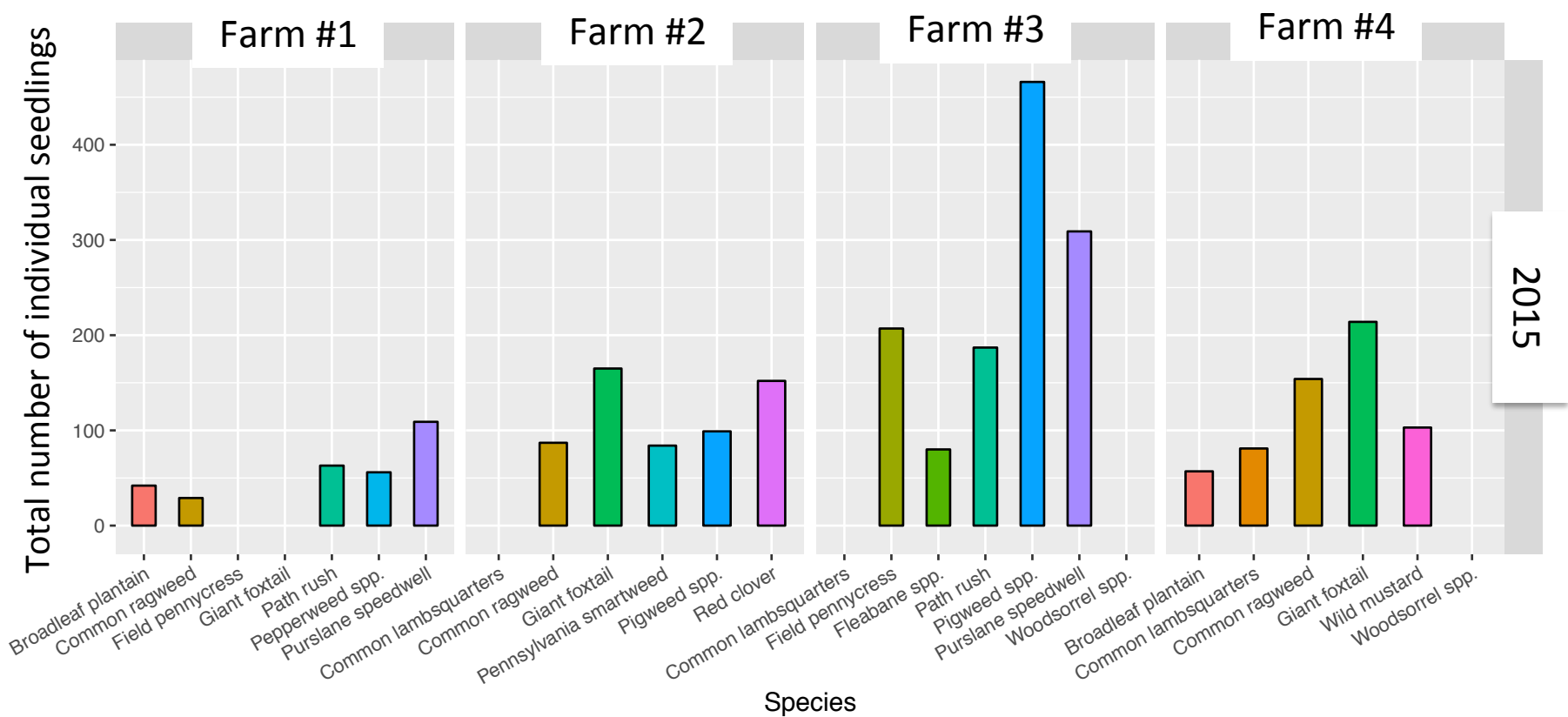
- Broadleaf plantain
- Common lambsquarters
- Common ragweed
- Field pennycress
- Fleabane spp.
- **Giant foxtail**
- Path rush
- Pennsylvania smartweed
- Pepperweed spp.
- **Pigweed spp.**
- **Purslane speedwell**
- **Red clover**
- Wild mustard
- Woodsorrel spp.

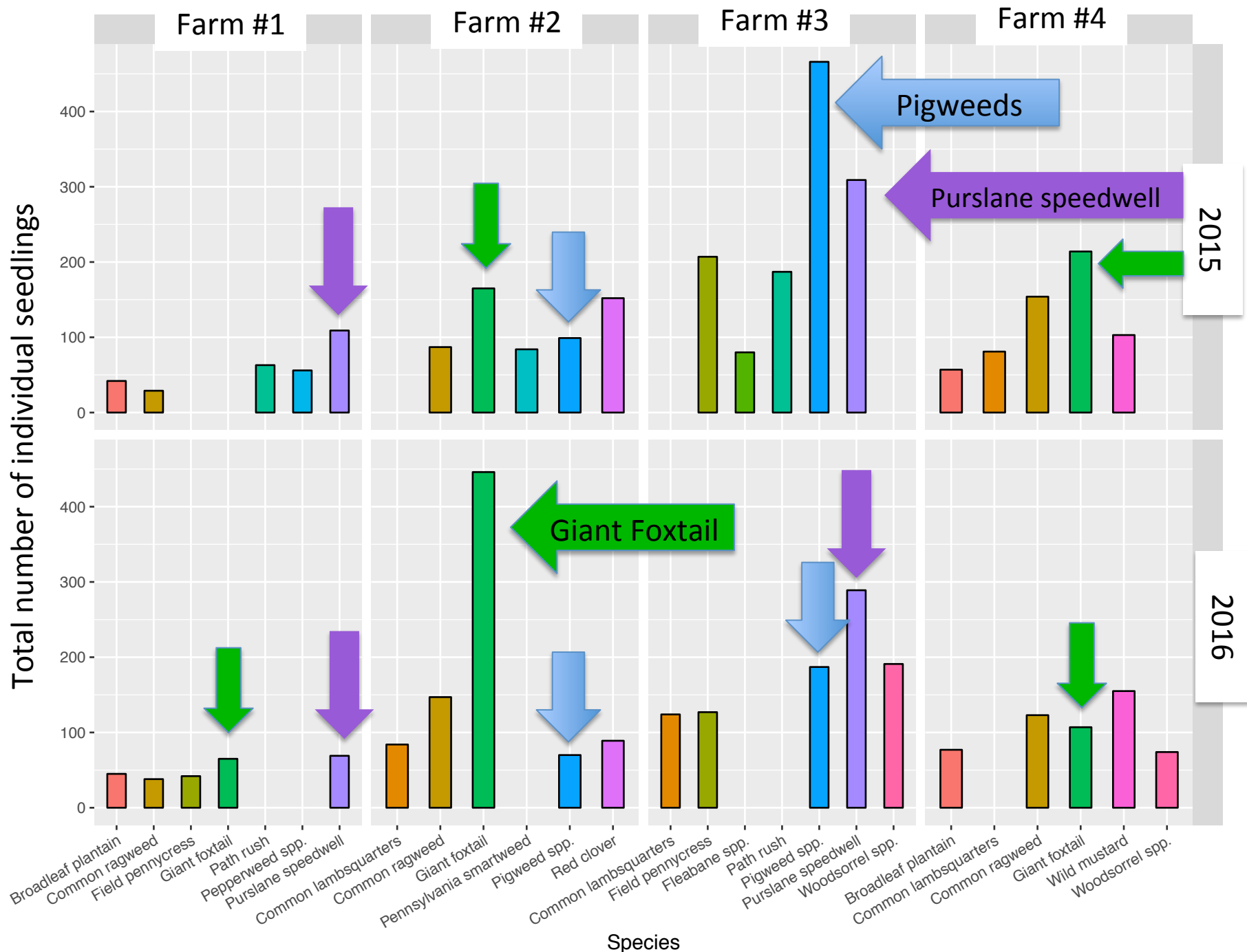




# How were the most common species distributed on the farms?







# About management and diversity

- Diverse rotations on these farms
  - Different niches for a high diversity of species
- Benefits?
  - Some weed species might perform similarly to cover crops
  - Greater biodiversity is typically assumed to be beneficial
  - High species richness can be good, especially when combined with low weed seedbank density.
- More species = more likely a problematic competitive species will be present
- Management considerations
  - Knowing what fields to avoid for certain crops
  - Knowing what weeds you have

# Take-home thoughts

- In 7 out of 8 site years, weed densities in weedy fields were at least 2x greater than clean fields
- “Clean” fields *don’t* have zero weed seeds
  - Different filters
- What you see aboveground is not necessarily representative of what you *could* be getting.
- These seedbank numbers might seem large, but they’re comparable to other studies in organic and non-organic fields
- Red clover is in soil seed banks
  - Its persistence could be beneficial
- Weed communities varied in number of species, and dominant species
  - Among and within farms

# Thank you!



Cudweed, with Water Droplet



# Acknowledgements

- OREI grant
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