From plan to planting: assessing outcomes in a large ag-conservation program

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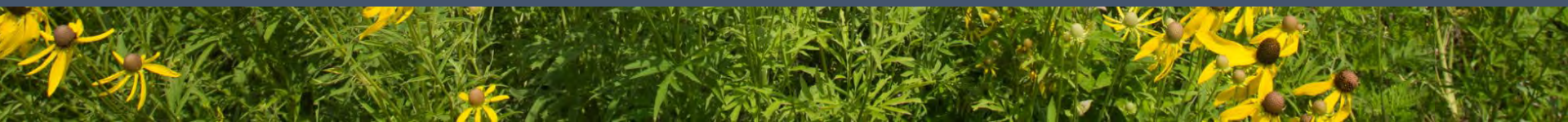


Conservation programs for specific ecosystem services

Emerging role of large ag conservation programs

Large conservation programs operating in ag landscapes strive to deliver services efficiently

- Conservation Reserve Program (CRP)
  - Targeted practices for specialized services
    - Erosion control, game bird habitat, historically
  - Utilize vast USDA infrastructure to operate at scale
  - Use revegetation as main tool

New role to address larger, more complex conservation issues

- More ecosystem rehabilitation activity
  - Rare/ declining habitat restoration
  - Pollinator and monarch recovery

Requirements for a successful program

As complexity of ecological goals increases, more prerequisites for achieving success

Traditional prerequisites for success

- Landowner adoption/program enrollment
- Planted acres

Ecosystem restoration prerequisites for success

- Dependable native seed supply and price
- Ecologically sound seed mix and management specifications
- Reliability in implementing specifications

Trends in reduced conservation funding necessitate increase efficiency as well

Are the large ag conservation programs able to deliver intended ecosystem services efficiently and effectively?

How well do these large programs work?

Pollinator Habitat Initiative (CP-42) Case Study

Pollinator Habitat Initiative (CP-42)

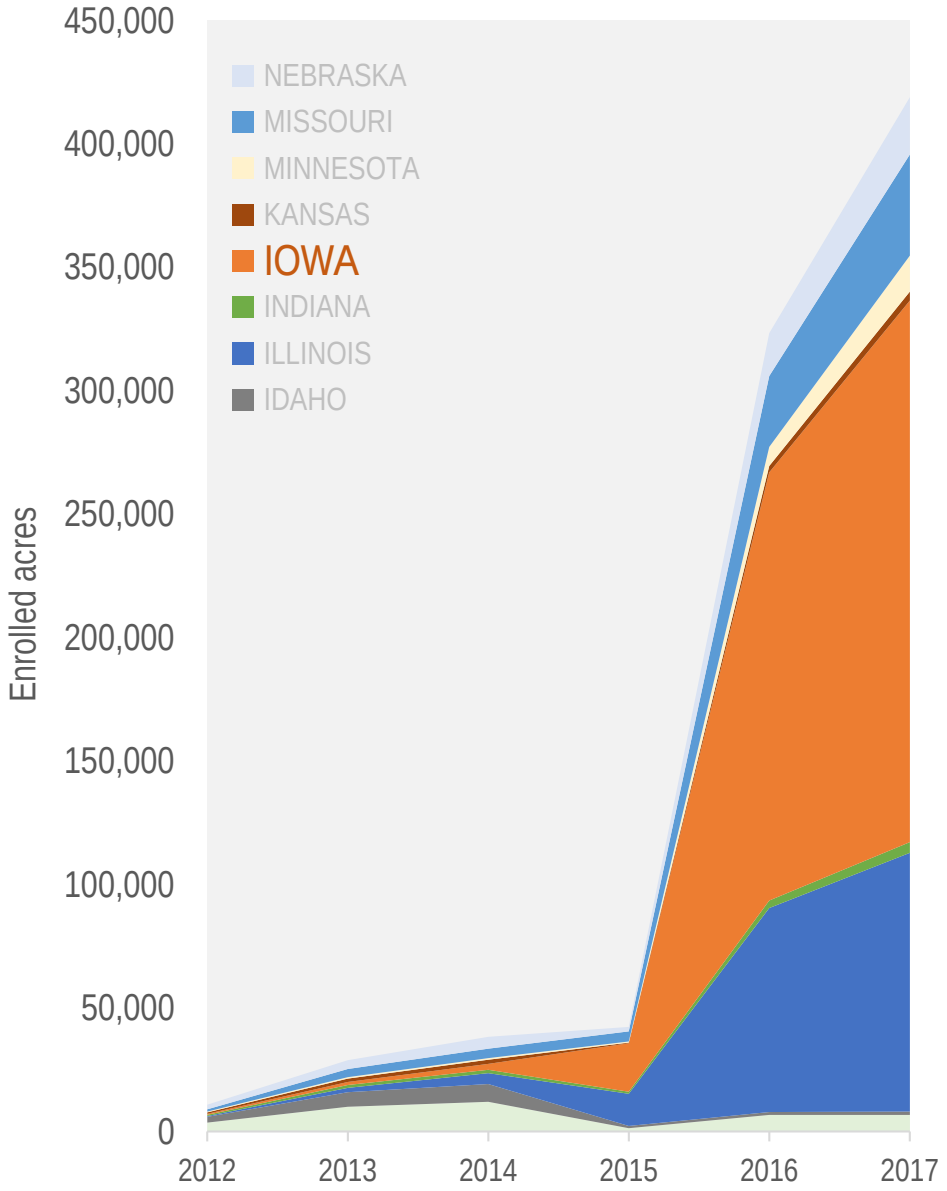
- Practice to improve pollinator habitat
- Initiated 2014, capped 2017/18
- "…create longer-lasting meadows of high-quality native wildflowers that support pollinators and other wildlife…"

By some metrics a massive success

- Farmer adoption high
- > 200,000 acres planted in IA alone

Was it efficiently implemented?

What were the ecological outcomes?



Pollinator Habitat Initiative (CP-42) Case Study

Research Framework

Examine the execution of the CP-42 practice in IA, assess ecological and implementation outcomes.

Three focus areas:

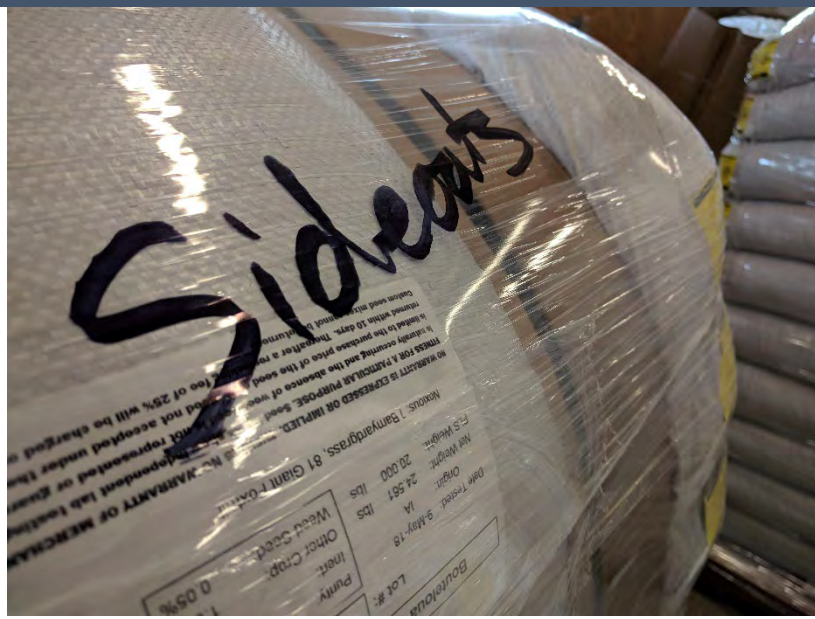
1. Dynamics of the native seed market over the course of the program
2. Verifying and improving seed mix design specifications
3. Measuring establishment success of 3yr old CP-42 pollinator plantings

1) Native seed market dynamics during CP-42

Objectives

1. Characterize seed cost changes during the program

2. Assess seed mix change in response to the program and market



1) Native seed market dynamics during CP-42

Methods

Track Market-wide Seed Costs

- Price lists/seed purchase quotes from annual UNI purchases from multiple Upper Midwest native seed growers
- Evaluate price fluxes 2015-2018

Assess CP-42 Seed Mix Costs

- FSA cost-share data from >800 CP-42 contracts
- Track seed cost per acre during the program (2014-2018)

Sample CP-42 Seed Mix Quality

- Seed mix sample from IA landowners enrolled in program
- Of 800 requests, procured 76 seed mixes
- Compare weighted mean coefficient of conservatism based on species seeding density with planting date.

1) Native seed market dynamics during CP-42

Preliminary Results- Seed cost changes

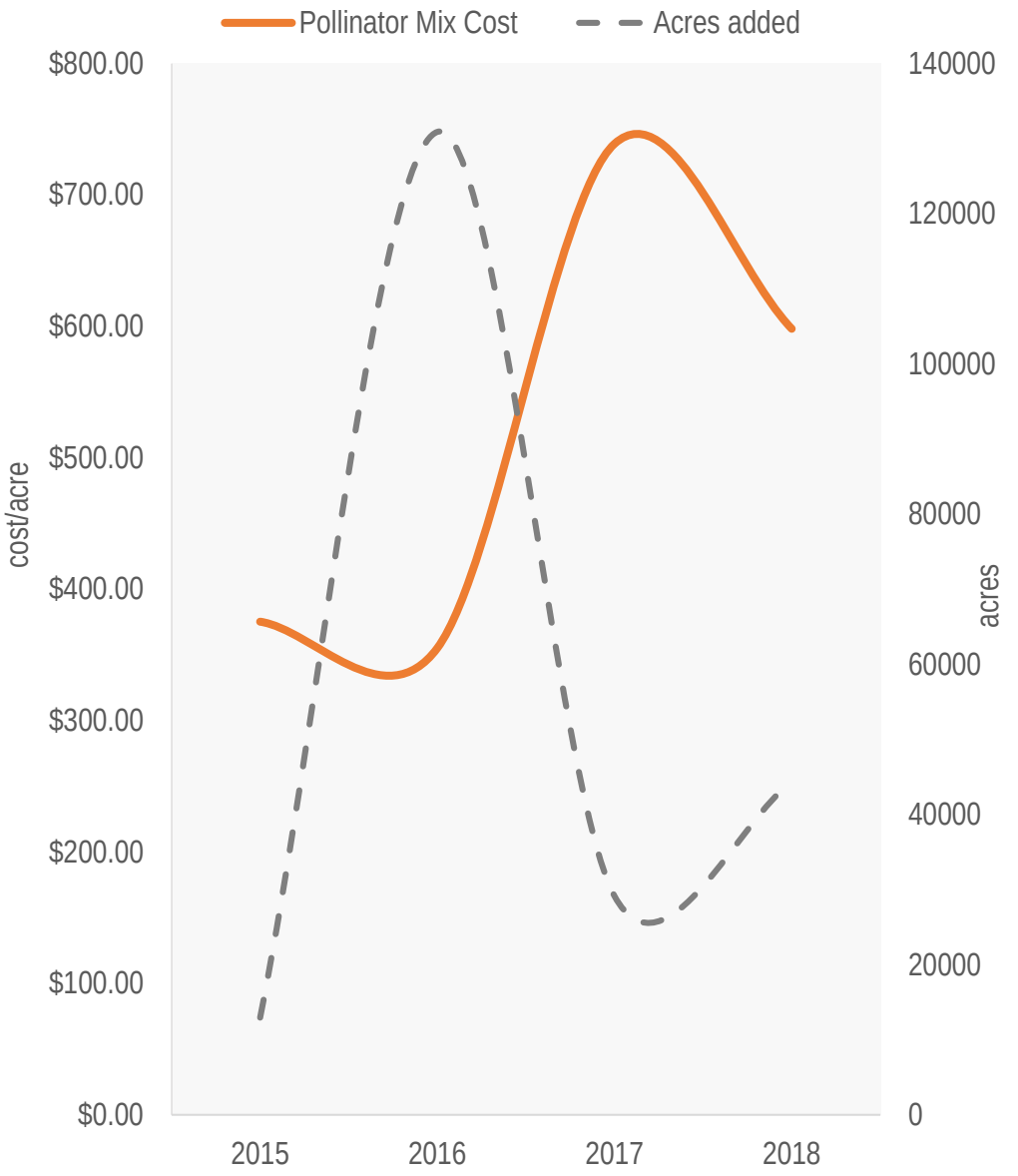
Over the course of the CP-42 program (2014-2018):

Acres planted rapidly increased

- 15k ac in 2015 to 175k ac in 2017

Seed prices increased strongly

- Avg forb price/oz increased +68%
- Some species prices increased >4x
- Same mix designed in 2015 cost 97% more in 2017



1) Native seed market dynamics during CP-42

Preliminary Results- Characterizing CP-42 seed mixes

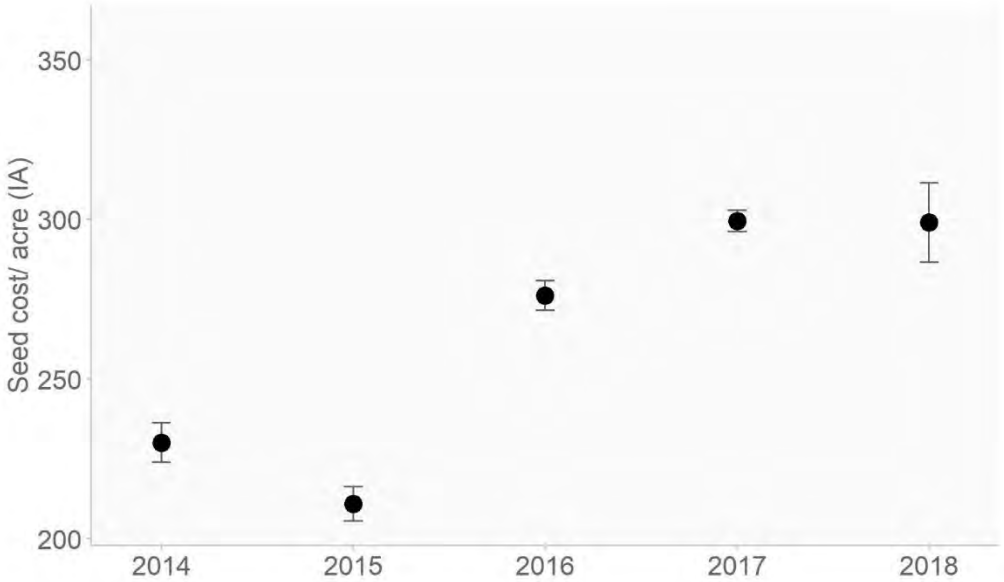
Over the course of the CP-42 program (2014-2018):

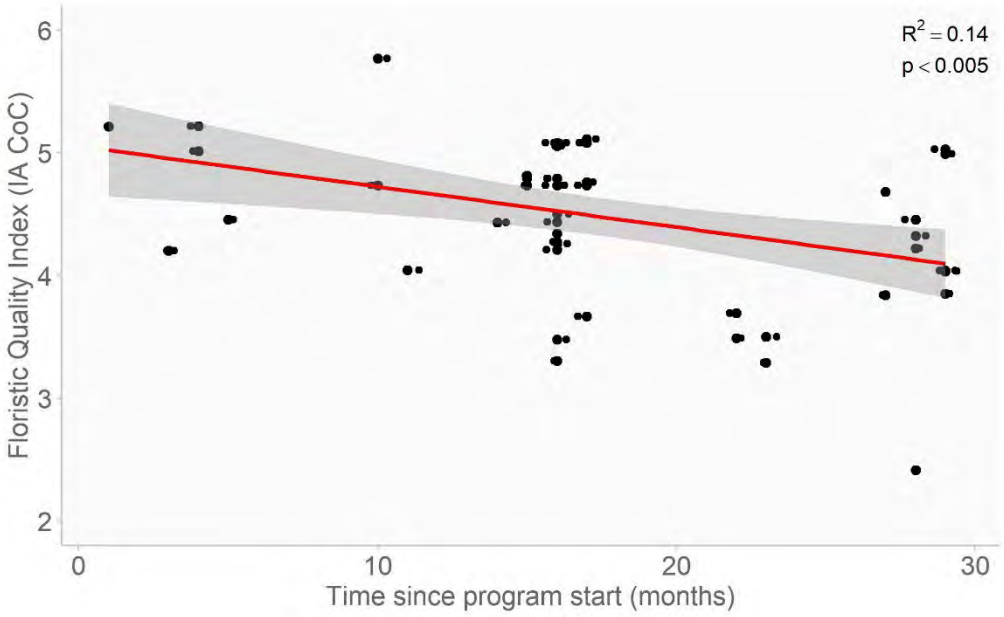
CP-42 seed mix prices increased

- Average cost rose +30%
- $210/acre low to $299/acre high
- Increased less than prices in general

Seed mix quality declined

- IA coefficient of conservatism decreased with more recent time of planting





1) Native seed market dynamics during CP-42

Preliminary Implications for Practice

More gradual roll-out of new programs

- Stabilize number of acres planted per year
- Allow use of cover crops to postpone planting during high demand years
- Avoid sudden demand surges

Improve the planning process

- Enable direct communication between seed suppliers and conservation planners

Improve quality assurance for native seeds

- Evaluate and close loopholes in seed mix design

2) Verifying and improving seed mix design specifications

Objectives

1. Evaluate establishment and ecosystem service provision for a typical pollinator mix

2. Compare performance among mixes used for pollinator habitat of differing specifications

2) Verifying and improving seed mix design specifications

Methods

Conduct Seed Mix Design Field Experiment

Split-plot design, two blocks

- n= 36, 3 seed mixes × 2 mowing treatments× 3 replicates × 2 blocks
- Drill seeded in spring 2015, Nashua, IA

3 Seed mix treatments

- Pollinator Mix: 1:3 grass:forb seeding ratio (CP-42), off-the-shelf
- Diversity Mix: 1:1 grass:forb, customized for site conditions (soils, climate)
- Economy Mix: 3:1 grass:forb (CP-25), off-the-shelf

Data collected 2015-2018

- Perennial weed cover
- Planted native stem density
- Inflorescence number

2) Verifying and improving seed mix design specifications

Results- Verifying pollinator mix performance

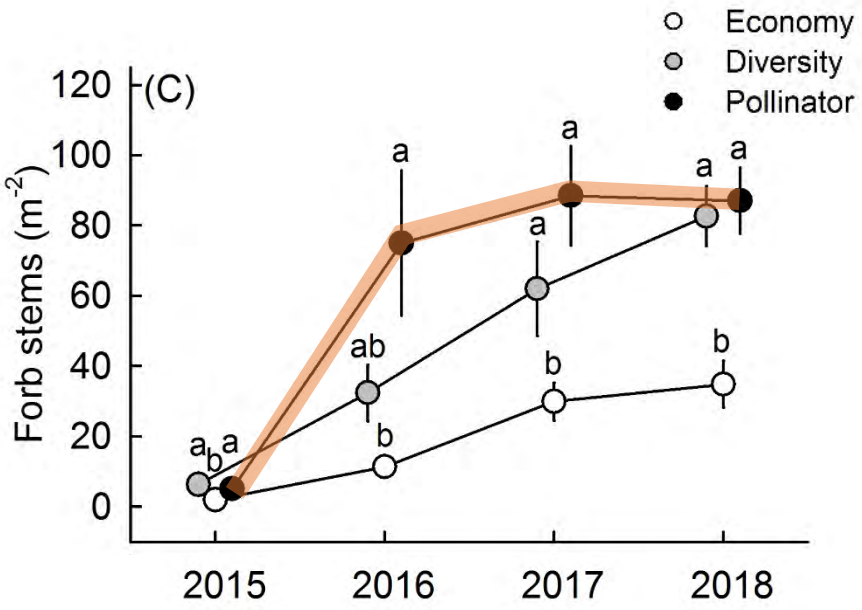
The Pollinator Mix (1:3 grass:forb seeding ratio):

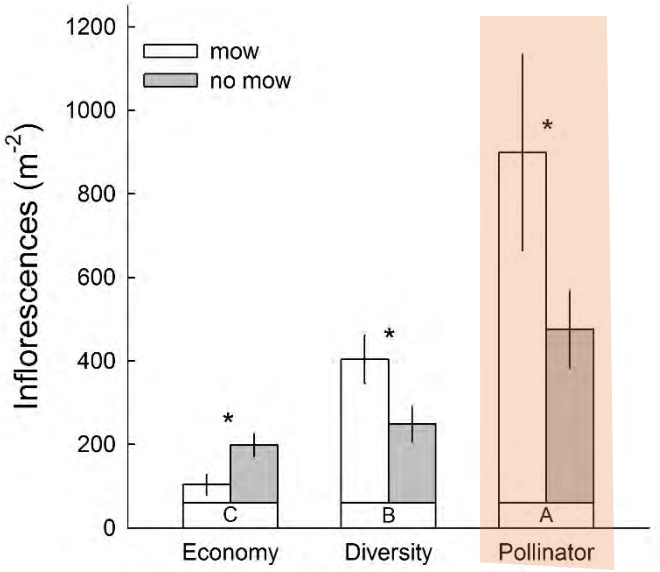
Supported pollinator forage plants

- High number of forb stems 3 of 4 years measured

Provided high abundance of floral resources

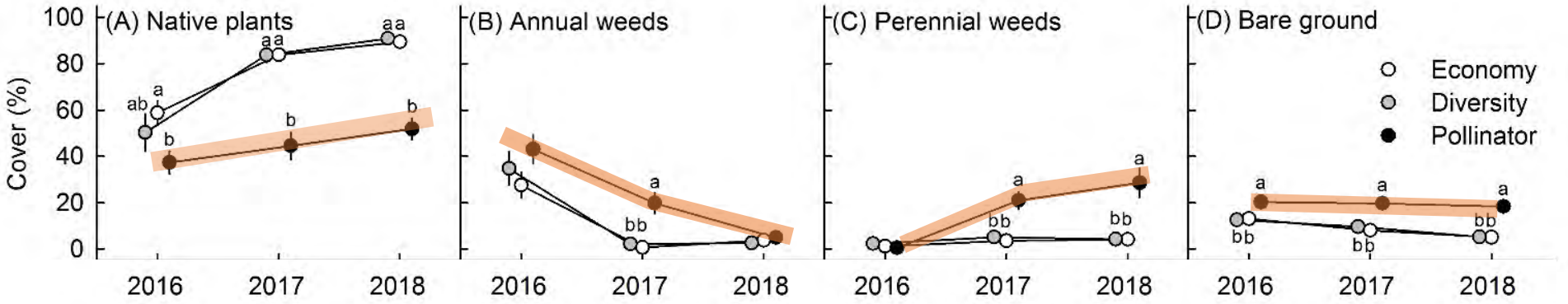
- Up to 900 inflorescences per square meter (cumulative over 4 years)





2) Verifying and improving seed mix design specifications

Results- Verifying pollinator mix performance



The Pollinator Mix (1:3 grass:forb seeding ratio):

Established poorly overall

- Only about 50% canopy cover sown native plants
- Bare ground/perennial weeds significant component of community after 3 years

At risk of invasion by perennial weeds

- Increase in perennial weed cover (Canada thistle, quackgrass) over time

2) Verifying and improving seed mix design specifications

Results- Improving seed mix design specifications

The Diversity Mix (1:1 grass:forb seeding ratio) performed almost as well as Pollinator Mix, with added benefits

Supported pollinator forage plants

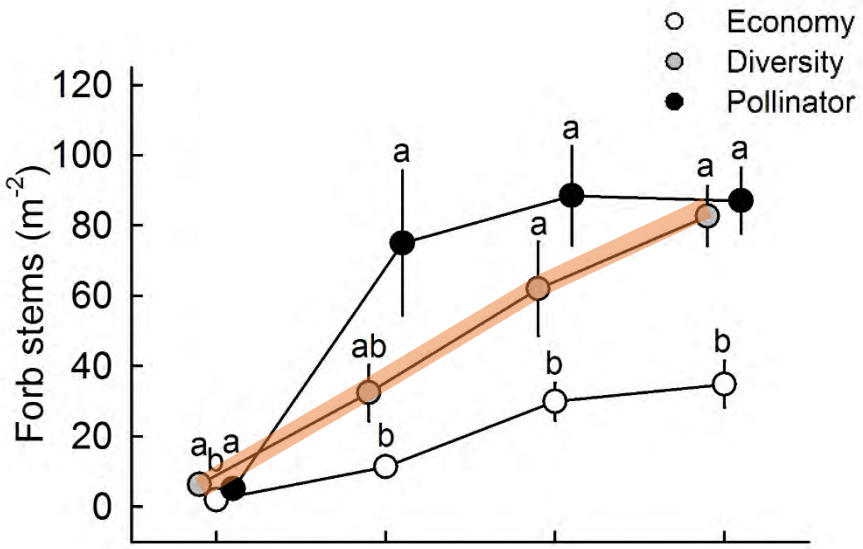
- Forb stem abundance no different than Pollinator Mix by year 4

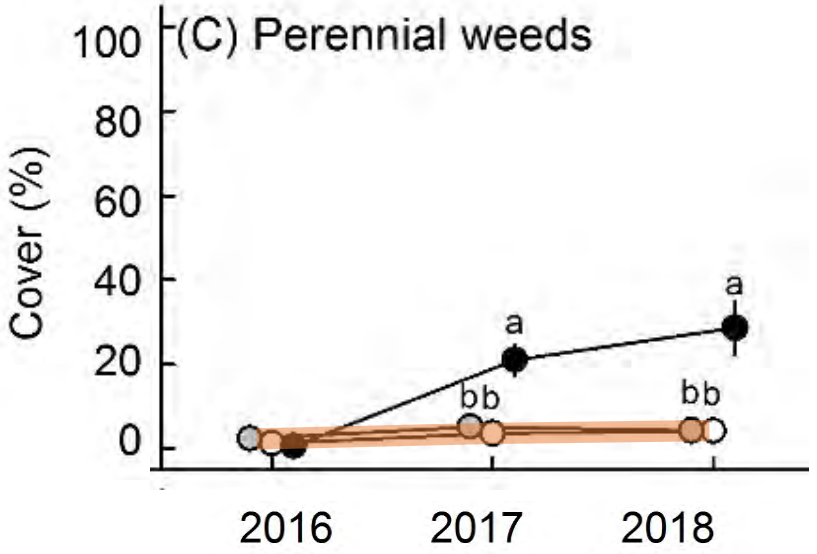
Provided fewer floral resources, but more variety

- Cumulative inflorescence production 60% of Pollinator Mix
- Floral diversity (Pielou's evenness) 60% higher than Pollinator Mix

Resistant to perennial weeds

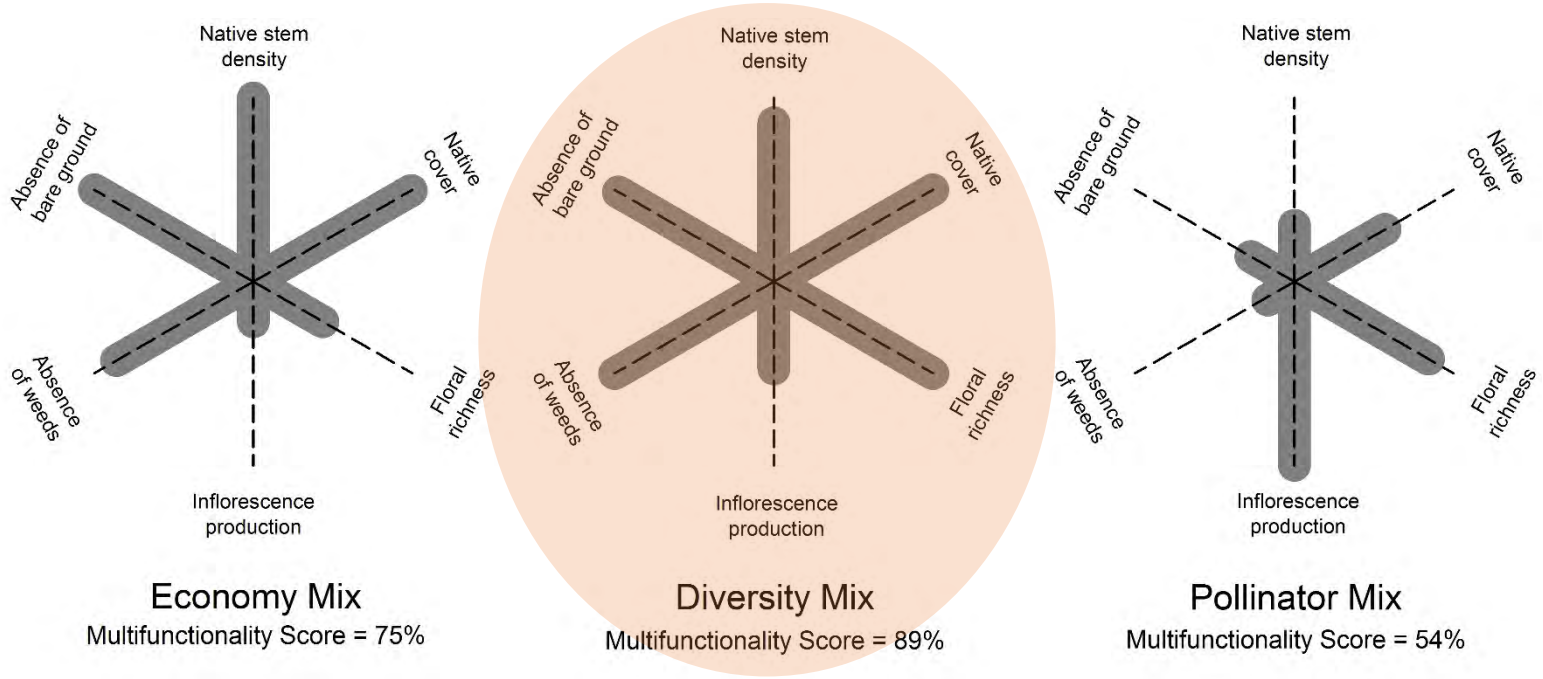
- Perennial weed cover <5% in Diversity Mix, but significant issue in Pollinator Mix (>25% vegetative cover and increasing)





2) Verifying and improving seed mix design specifications

Results- Improving seed mix design specifications



The Diversity Mix (1:1 grass:forb seeding ratio):

Highly multifunctional

- In relative comparison with other mixes among ecosystem services, Diversity Mix provided more services at once (compared to optimization of one or few)

Cost effective

- Cost less than Pollinator Mix, but provided most of the benefits and more. Costs to produce 1k native stems much less than the Pollinator Mix

2) Verifying and improving seed mix design specifications

Preliminary Implications for Practice

Current seed mix specifications result in mixed ecological outcomes

- Low grass to forb ratio (1:3) helps improve pollinator habitat metrics but not great for other ecosystem functions
- Inefficient since they are high cost, low establishment

Seed mix specifications could be improved for cost-effectiveness and multifunctionality

- Balanced grass to forb ratio (1:1) with many species and functional groups performs almost as well for pollinators, but also resists weeds and provides more cover
- More cost efficient- moderate cost, high establishment

3) Evaluating success of CP-42 pollinator plantings

Objectives

1. Characterize overall vegetation outcomes on IA CP-42 plantings

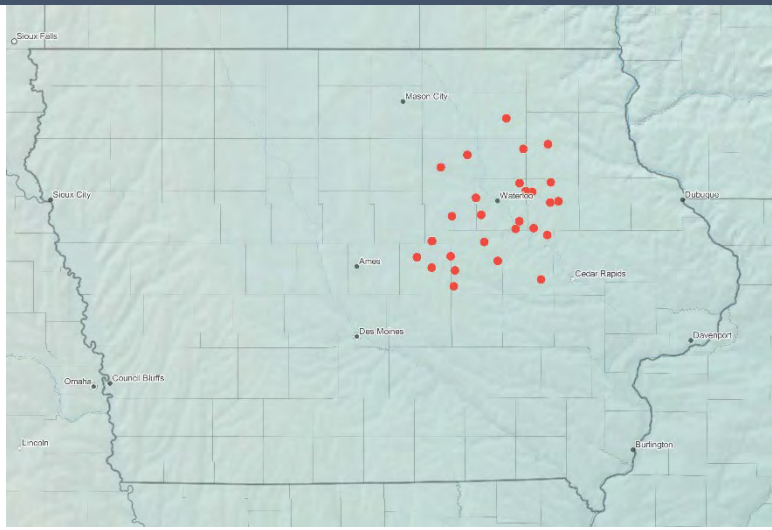
2. Compare seed mixes planted to established stands

3) Evaluating success of CP-42 pollinator plantings

Methods

Vegetation surveys

- Randomly chosen 26 sites in 10 NE IA counties
- Seed mixes obtained through farmer surveys
- Restricted random sampling pool to only sites with an actual seed mix (not NRCS seed plan)



Data collected 2018

- Forb density (stems and plants)
- >20cm tall (no seedlings sampled)
- 3 yr old plantings (NRCS criteria for “established”)

Evaluate characteristics of sown and established forbs

- Most common species
- Establishment success

Compare mixes planted to established stands

- NMDS ordination

3) Evaluating success of CP-42 pollinator plantings

Preliminary results- The average NE Iowa CP-42 planting

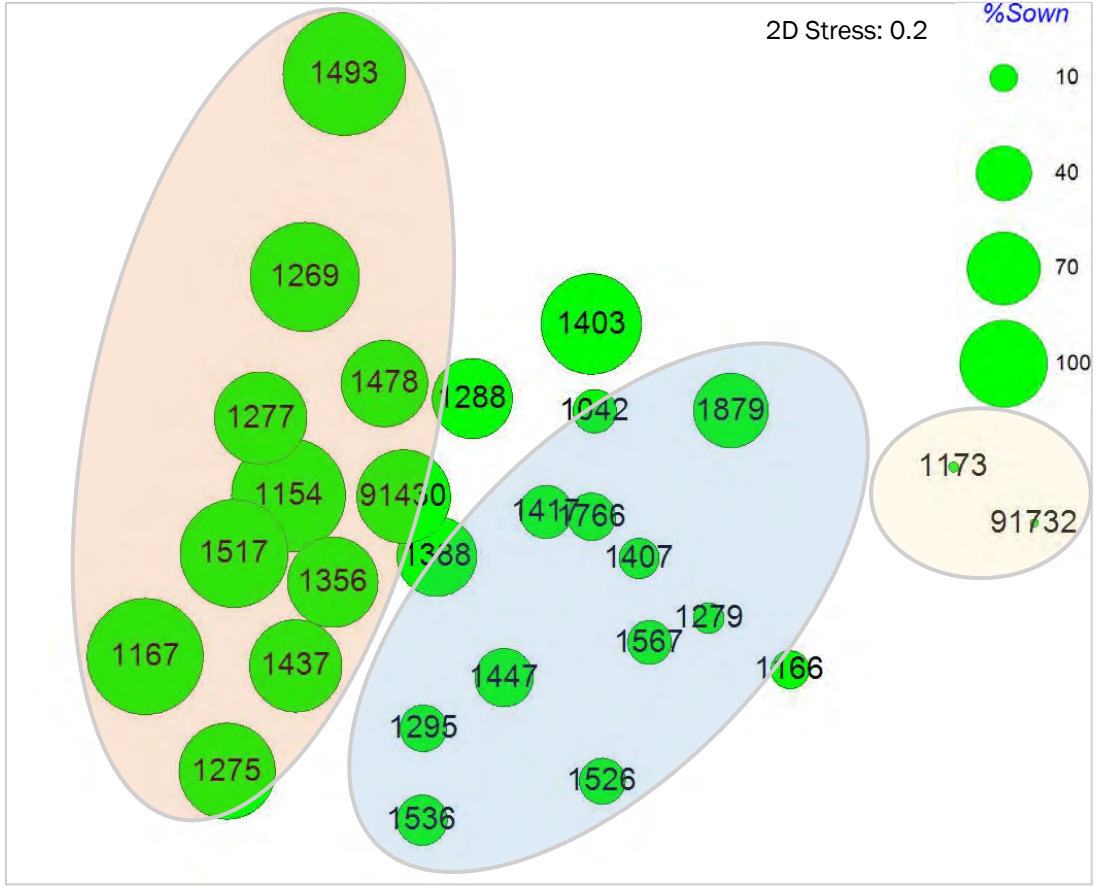
Outcomes mixed

- Generally low establishment, even after 3 years (plant density 36% of sown density)
- About half of species planted were present in established stands

Three emergent kinds of plantings

- Majority of plants in the resulting stand were sown in the seed mix (~45%)
- Majority of plants in the resulting stand were not sown, i.e. weeds (~45%)
- Almost no plants in the resulting stand were in the seed mix (<10%)

Variable	Value	SE
Avg # forb species planted	24.6	1.1
Avg # forb species present	13.4	0.8
Avg forb establishment overall	0.36	0.14

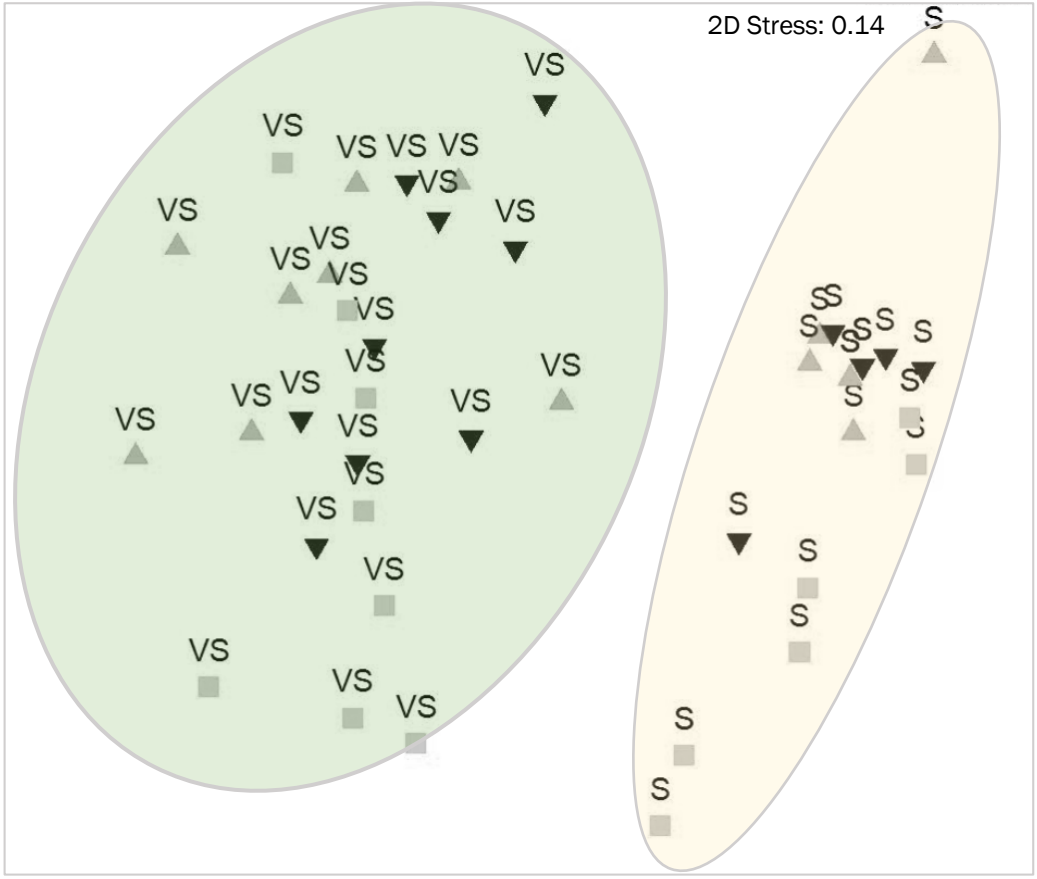


3) Evaluating success of CP-42 pollinator plantings

Preliminary results- Relating seed mix to established stand

Seed mixes planted were very distinct from established stands

- Not as much variation among seed mixes as among established stands
- Many seed mixes identical



3) Evaluating success of CP-42 pollinator plantings

Preliminary Implications for Practice

CP-42 plantings need to be evaluated due to highly variable outcomes

- Pollinator seed mixes not a blueprint for the resulting stand- no shortcuts for vegetation monitoring

Mid-contract management an opportunity for improvement

- Overseeding potential to increase initially sown species

More research needed to identify why establishment so poor at some sites

Summary

Examine the execution of the CP-42 practice in IA, assess ecological and implementation outcomes.

1. **Dynamics of the native seed market over the course of the program**
    1. The rapid program roll-out resulted in price spikes for seed followed by declines in seed mix quality
2. **Verifying and improving seed mix design specifications**
    1. Forb dominated seed mix specs support pollinator forage, but balanced forb and grass mixes are almost as good, cheaper, and more multifunctional
3. **Measuring establishment success of 3yr old CP-42 pollinator plantings**
    1. About half of plantings resulted in sown forb dominated stands, and seed mixes were unreliable models for the established stands

Conclusions

Room for improvement in large ag conservation programs

- More gradual roll-out of new programs
- Support research into mix design, planting practices, and establishment in concert with program roll-out
- Require monitoring in practice rules

Acknowledgements

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