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The Impact of Soil Water Storage Capacity on Species-specific Forb Establishment in CP42 Fields

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Background
- The loss of tallgrass prairie habitat has likely contributed to decline in North American pollinator communities.¹
- To combat these losses the Conservation Reserve Program (CRP) created Conservation Practice (CP) 42 to re-establish pollinator habitat on the landscape.²
- One factor that could influence forb establishment in CP42 fields is the water storage capacity of the soil.
- In this study, we test whether soil water storage capacity to 25 cm influences floral resources or species-specific forb establishment in 35 randomly selected CP42 fields.

Methods
- In 2018 and 2019, we surveyed 35 randomly-selected, three-year old CP42 fields near Cedar Falls, Iowa.
- At each site, we recorded total stem density of all species in 75 - 1 m² quadrats.
- Quadrats were systematically sampled (at 7m intervals) along the length of five, randomly positioned 100m transects.
- Percent cover of bare ground, sown warm-season grasses, sown cool-season grasses, and unsown cool-season grasses, were recorded.
- We assessed floral resources at 30 sites as the total number of flowers of each species in 50 - 1 m² quadrats.
- A floral resource index (based on whether the site met the bloom period goals of CP42, its floral resource diversity, and its forb stem density during each bloom period) was computed for each site.³

Analysis
- We assessed species-specific forb establishment for the seven most commonly sown species in 2018 and 2019.
- At each site, we computed establishment as: the number of plants per acre divided by the number of sown pure live seeds per acre, for each species.
- We obtained the water storage capacity to 25 cm and corn suitability ratings (CSR2) for each site from the Iowa Soil Survey.
- We assessed whether water storage capacity and CSR influenced species-specific forb establishment and the total floral resource index of the site using linear regression.
- We compared species-specific forb establishment between 2018 and 2019 using one-way ANOVA.

Results

Species-specific Establishment

<table>
<thead>
<tr>
<th>Species</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamaecrista fasciculata</td>
<td>359.8 (306.4)</td>
<td>75.3 (41.9)</td>
</tr>
<tr>
<td>Asclepias tuberosa</td>
<td>68.5 (37.7)</td>
<td>8.2 (3.6)</td>
</tr>
<tr>
<td>Asclepias syriaca</td>
<td>24.5 (7.1)</td>
<td>9.9 (3.7)</td>
</tr>
<tr>
<td>Heliopsis helianthoides</td>
<td>12.0 (3.6)</td>
<td>7.0 (2.6)</td>
</tr>
<tr>
<td>Monarda fistulosa</td>
<td>4.5 (1.1)</td>
<td>5.5 (2.6)</td>
</tr>
<tr>
<td>Rudbeckia hirta</td>
<td>2.0 (0.5)</td>
<td>5.2 (2.3)</td>
</tr>
<tr>
<td>Dalea purpurea</td>
<td>1.5 (0.4)</td>
<td>0.7 (0.2)</td>
</tr>
</tbody>
</table>

Table 1. Species-specific establishment in 2018 and 2019. Most species had higher establishment rates in 2018 than in 2019 and three species (A. tuberosa, A. syriaca, and D. purpurea) had marginally higher establishment in 2018 than in 2019.

Conclusion
- The water storage capacity and corn suitability rating of a site had minimal impact on floral resources or establishment in most species. R. hirta performs poorly in wet soil which could account for the negative relationship between establishment and soil moisture.
- This lack of correlation is most likely due to the young age of the stands (3 years) and the potential influence of other factors on forb establishment (e.g., annual variation in spring rain, different seed stock and suppliers, different management, and varying weed pressure).
- Sites from 2018 and 2019 had comparable CSR and water storage capacities, suggesting that differences in establishment were due to superior conditions for forb establishment in spring 2016 than in spring 2017.

Management Recommendations
- 10-year CRP contracts are likely not of sufficient length for soil based impacts on forb establishment to manifest; consequently, sites with low CSR and sites with low water storage capacity should not be excluded from CP42.
- C. fasciculata, A. tuberosa, A. syriaca, H. Helianthoides, M. fistulosa, R. hirta, and D. purpurea are reliable establishing species for CP42 across a variety of soil types in Iowa.

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2) USDA FSA. "CP42 Pollinator Habitat." Available at: https://www.fsa.usda.gov/InternetFSA_File/cp42_habitat.pdf