Practical On-Farm Pollinator Habitat

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Duluth, MN

Joan Olson
Prairie Drifter Farm
Litchfield, MN

MOSES Conference
February 2020
The Xerces Society for Invertebrate Conservation

Re-wilding agriculture for biodiversity conservation

Xerces blue butterfly (Glaucopsyche xerces), the first U.S. butterfly to go extinct due to human activities

Habitat Restoration
- Supported over 200,000 acres of new habitat in 2019

Pollinator Conservation Education
- Direct outreach to over 23,000 farmers, agency professionals, and others in 2019
Prairie Drifter Farm: Certified Organic Vegetable Farm in Litchfield, MN

• 33 acre farm with 5+ acres in vegetables
• 200+ member CSA
• Serve 2 food co-ops, food shelves and local foods restaurant

Photos: Joan Olson
Prairie Drifter - Xerces Collaborations: Habitat Trials & Field Days

- Solarization trials
- Insectary strips from plugs
- Reed Canary / Pigs trials
- Native Hedgerows

Photos: Sarah Foltz Jordan
Habitat is key for pollination & natural pest control

Photos: Sarah Foltz Jordan, Thelma Heidel-Baker, Adam Varenhorst, Nancy Adamson, Sarah Nizzi
Not that surprising:

Landscape complexity enhances natural beneficial insect populations in 74% of cases (Bianchi et al. 2011)

Pollinator habitat: there’s something for everyone!

- Pollinator habitat options
- Habitat restoration process
  - Site prep, planting, weeding & management
- Lessons learned at Prairie Drifter Farm
Part 1: Habitat Options in Ag Landscapes

- Native Field Borders
- Conversion of Retired Crop Land, Fallow Areas
- Native Insectary Strips
- Beetle Banks
- Cover Crops & Intercrops
- Flowering Hedgerows
- Filter Strips, Wetlands, Buffers
- Flowering Pasture & Rangeland
- Orchard Understory Plantings
- Drift Protection (non-flowering hedgerows)

Photo: Sarah Foltz Jordan, The Xerces Society
On-Farm Pollinator Habitat Opportunities: Native Wildflower Plantings

Field Borders, Filter Strips, Conservation Cover, CRP Plantings, etc.

- Larger footprint prairie restorations
- Intended to be permanent native vegetation

Roger Larson Farm, Princeton, MN

Photo: Sarah Foltz Jordan
Prairie Drifter Farm: Filter Strip Plantings

Photo: Joan Olson
Conversion of erosion-prone croplands

Scattergood Farm
West Branch, IA

Photos: Sarah Foltz Jordan, Xerces Society
On-Farm Pollinator Habitat Opportunities: Native Insectary Strips

• Linear strips of native wildflowers
• Dispersed throughout crop fields

Sogn Valley Farm, Cannon Falls, MN

Photo: Karin Jokela
Case Study: Vilicus Farms, Havre, MT

- >5500 acres organic grains, pulses, & oilseed crops

- Native plant strips throughout farm, mostly ~30 ft. wide, totaling over 100 acres

- 20+ species of drought tolerant native forbs and grasses

Photos: Sarah Foltz Jordan, Jennifer Hopwood
Insectary Strips with Plugs (rather than seed)
Prairie Drifter Farm, Litchfield, MN

Photos: Sarah Foltz Jordan

June 2016
Insectary Strips with Plugs (rather than seed)
Prairie Drifter Farm, Litchfield, MN

Rapid Restoration!

- Dense & diverse wildflowers just ONE YEAR after planting
- Very little weed management needed
- Low Cost if growers propagate some of the natives

August 2017

Photo: Sarah Foltz Jordan / Xerces Society (left), Joan Olson (right)
Insectary Strips with Plugs (rather than seed)

June 2016

July 2017

Uproot Farm, Princeton, MN

Photos: Sarah Foltz Jordan
On-Farm Pollinator Habitat Opportunities: **Beetle Banks**

Permanent native grass strips intercropped with vegetables or row crops

Beetle banks enhance pest control:
- Predatory beetles feed on aphids, flies, slugs, cutworms, mites, insect eggs, etc.
- Several ground beetle spp. can consume ~40 weed seeds per square foot/day
On-Farm Pollinator Habitat Opportunities: **Annual Insectary Strips**

- Temporary mass wildflower plantings between row crops
- Low cost
- Rapidly blooming species
- Minimal site preparation
- Can provide multiple benefits (Cut flowers, Nitrogen-fixing; Weed control...)

Open Hands Farm, Northfield, MN

Photo: Sarah Foltz Jordan, Debbie Roos

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On-Farm Pollinator Habitat Opportunities: **Annual Insectary Strips**

- Partridge pea
- Plains coreopsis
- Annual blanket flower
- Buckwheat
- Dill
- Cilantro
- Sunflower
- Allysum
- Phacelia
- Holy basil
- Red clover
- Bachelor’s button
- Cosmos
Prairie Drifter Farm: Annual Plantings

Photos: Joan Olson (left); Sarah Foltz Jordan (right and center)
On-Farm Pollinator Habitat Opportunities: **Cover Cropping**

To benefit pollinators:
Allow cover crop to bloom before incorporating or mowing.

Photo: Karin Jokela / Xerces Society
Lots of options for cover crops that support beneficial insects!

- **Buckwheat** (*Fagopyrum esculentum*)
- **Lacy phacelia** (*Phacelia tanacetifolia*)
- **Partridge pea** (*Chamaecrista fasciculata*), also known as partridge pea
- **Brassica spp.**

Photos: Nancy Adamson
Flowering Cover Crop Trials
Agua Gorda Cooperative, Prairie Drifter Farm, Uproot Farm, Sogn Valley Farm

Oats, Peas, Med. Red Clover

Oats, Peas, Diverse Clovers

Oats, Peas, Clovers, Buckwheat, Sunflower, Phacelia
Additional Flowering Cover Crops at Prairie Drifter Farm

Photos: Joan Olson

- Hairy Vetch
- Oats with Buckwheat
Flowering covers integrated into crop rotation

Year 1: Barley (cash crop) with alfalfa growing in understory
Year 2, 3, 4: Alfalfa (hayed twice per year for 3 years)
Year 5: Plow down and fallow, incorporating with tillage a few times, fall seed to wheat or seed the following spring to oats
Year 6: Wheat or Oats (cash crop)
Year 7: Cattle Feed Mix (flax, barley, peas) for cash crop
   A. Sow with yellow sweet clover or alfalfa underneath
   B. Leave out the understory legume (continue to Year 8)
Year 8: Spring or fall cover crops and graze, plow down, or mow.
Year 9: Wheat, Oats, or Barley (cash crop)
Flowering Cover Crops Enhance Pest Control

Tillman 2013: Flowering cover crops near soybeans (buckwheat for nectar) increased wasp parasitism of stink bug eggs by 2½ times.
On-Farm Pollinator Habitat Opportunities: **Flower-Rich Pastures**

- Include diverse legumes or other forbs that provide pollen and nectar
- Ensure adequate rest-periods to allow flowers to bloom

Photo: Toby Alexander, NRCS
On-Farm Pollinator Habitat Opportunities: Flower-Rich Rangeland

Casey Bailey Farm, Fort Benton, Montana
On-Farm Pollinator Habitat Opportunities:  Native Flowering Hedgerows

Little Hill Berry Farm, Northfield, MN

- Early Spring Forage
- Nesting resources for stem nesting insects
- Screening, wind and dust reduction, living snow fences
- Harvestable fruit, tea
- Seed/berries for birds
- Great option when weed pressure is high

Photos: Sarah Foltz Jordan
A Few Key Native Flowering Shrubs

- **Elderberry** (black and red) (*Sambucus* spp.)
- **Juneberry** (*Amelanchier* spp.)
- **Highbush cranberry** (*Viburnum trilobum*)
- **Nannyberry** (*Viburnum lentago*)
- **Cockspur Hawthorn** (*Crataegus crus galli*)
- **Wild plum** (*Prunus americana*)
- **Aronia** (*Aronia melanocarpa*)
- **Currants** (*Ribes* spp.)
- **Raspberries & Blackberries** (*Rubus* spp.)
- **Roses** (*Rosa* spp.)
- **New Jersey Tea** (*Ceanothus americanus*)
- **Hazelnut** (*Corylus americana*)**
- **Dogwood** (*Cornus* spp.)
- **Willow** (*Salix* spp.)
- **Lead plant & False indigo** (*Amorpha* spp.)

*Plants in blue provide edible product*
On-Farm Pollinator Habitat Opportunities: Native Flowering Hedgerows

Native elderberry & currant hedgerow

Diverse native hedgerow with forb component

Photos: Sarah Foltz Jordan, Xerces Society
Prairie Drifter Farm: Native Hedgerows

Landscape Fabric for Weed Control

Photos: Joan Olson

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Prairie Drifter Farm: Native Hedgerows

Biodegradable Weed Suppressant Mat

*NOT ORGANIC due to synthetic binder

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Deer protection is (usually) essential

Photos: Karin Jokela, Xerces Society;  Sarah Foltz Jordan, Xerces Society
On-Farm Pollinator Habitat Opportunities:  Native Tea Garden

Photos: Practical Farmers of Iowa

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## Native Teas & Culinary Herbs in the Midwest

<table>
<thead>
<tr>
<th>Herb</th>
<th>Parts Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arise Hyssop (Agastache foeniculum &amp; A. foeniculum)</td>
<td>Leaves &amp; flowers, fresh or dried</td>
</tr>
<tr>
<td>Mountain Mint (Monarda punctata)</td>
<td>Leaves &amp; flowers, fresh or dried</td>
</tr>
<tr>
<td>Bee Balm (Monarda fistulosa)</td>
<td>Leaves &amp; flowers, fresh or dried</td>
</tr>
<tr>
<td>New Jersey Tea (Ceanothus americanus)</td>
<td>Leaves, fresh or dried</td>
</tr>
<tr>
<td>Goldenrod (Solidago spp.)</td>
<td>Flowers, fresh or dried</td>
</tr>
<tr>
<td>Stinging Nettle &amp; Wood Nettle (Urtica dioica &amp; Laportea canadensis)</td>
<td>Leaves, fresh or dried</td>
</tr>
<tr>
<td>Raspberry (Rubus spp.)</td>
<td>Leaves, fresh or dried</td>
</tr>
<tr>
<td>Rose (Rosa spp.)</td>
<td>Flowers and rose-hips, fresh or dried</td>
</tr>
<tr>
<td>Smooth &amp; Hairy Sumac (Rhus glabra &amp; R. typhina)</td>
<td>Berries, fresh or dried</td>
</tr>
<tr>
<td>White Cedar (Thuja occidentalis)</td>
<td>Needles, fresh or dried</td>
</tr>
<tr>
<td>Spruce &amp; Fir (Picea spp. &amp; Abies spp.)</td>
<td>Needles, tips, fresh or dried</td>
</tr>
<tr>
<td>Wintergreen (Gaultheria procumbens)</td>
<td>Leaves, fresh or dried</td>
</tr>
</tbody>
</table>

Photos by: Minette Tonoli, Sarah Foltz Jordan, Matt Lavin, Wikimedia Commons, & John Oyston.
Part 2: Habitat Installation Process

- Habitat Evaluation
- Site Selection
- Planting Design & Species Selection
- Pre-planting Weed Control
- Habitat Installation
- Ongoing Weed Management
Site Selection:
Choose areas protected from pesticide drift

Protecting Conservation Plantings from Pesticides
Guiding Principles for Project Planning and Implementation

1. Choose areas protected from pesticide drift. Preferably, protect sensitive areas from drift with physical barriers, such as fences or physical dividers. Avoid areas that are not protected from drift, such as those near roads or other sources of wind or water. Consider the wind direction and speed, as well as the season and weather conditions.

2. Use buffer strips and other natural barriers to protect sensitive areas. Choose areas that are protected from drift with buffer strips, such as rows of trees or shrubs. Avoid areas that are not protected from drift, such as those near roads or other sources of wind or water. Consider the wind direction and speed, as well as the season and weather conditions.

3. Avoid areas that are susceptible to drift damage. Choose areas that are protected from drift with buffer strips, such as rows of trees or shrubs. Avoid areas that are not protected from drift, such as those near roads or other sources of wind or water. Consider the wind direction and speed, as well as the season and weather conditions.

4. Use buffer strips and other natural barriers to protect sensitive areas. Choose areas that are protected from drift with buffer strips, such as rows of trees or shrubs. Avoid areas that are not protected from drift, such as those near roads or other sources of wind or water. Consider the wind direction and speed, as well as the season and weather conditions.

Photo: Karin Jokela / Xerces Society
Drift Protection Buffer

- Spruce, fir, cedar
- Multiple rows if possible
- Aim for ~60% density

Photo: Karin Jokela / Xerces Society
Organic Site Preparation for Wildflower Establishment

- Smother Cropping
- Solarization
- Repeat Cultivation
- Soil inversion
- Organic Herbicides
- Sheet Mulching
- Sod Removal
- Weed barriers
- Livestock Rooting
- Burning/Grazing
Smother Cropping: high density cover crop to outcompete weeds

• Duration: 1 or more growing seasons
• Timing is essential
• Requires attentive management to be effective
• Species selection varies based on soils & weeds
• Termination methods vary (mowing; winter kill; cultivation)

Photos: Kelly Gill, Sarah Foltz Jordan
Smother Cropping: Buckwheat
Del’s Orchard, Leonard, MN

Invasive Weeds

Buckwheat Smother Crop Summer 2015

Seeding Fall 2015

Summer 2017

Photos: Sarah Foltz Jordan, Del Stubbs
Buckwheat Site Prep for Insectary Strips
Scattergood Farm, West Branch, Iowa

Photos: Sarah Foltz Jordan / Xerces Society

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Smother Cropping: Oats & Proso Millet
York Farm, Hutchinson, MN

Spring 2017:
Oat Smother Crop

Summer 2017:
Proso Millet Smother Crop

Oct. 2017
Light drag;
Broadcast
Seeding;
Cultipacking

July 2016
Starting conditions: mostly quack grass

Photos: Sarah Foltz Jordan
Smother Cropping: Japanese Millet & Sorgum Sudangrass
Waxwing Farm, Webster, MN

Summer 2016
Starting conditions: wet weedy crop field (quack grass, water smart weed, annual weeds)

Summer 2017
50:50 Sorghum Sudan: Japanese Millet Smother

Summer 2018
Sorghum Sudan Smother

Oct-Nov. 2018
Controlled Burn & Seeding

Photos: Karin Jokela; Waxwing Farm
Smother Cropping Species

Lots of Options:

- Buckwheat
- Millet spp.
- Sorghum sudan
- Alfalfa
- Crimson Clover
- Oats, Peas, Red Clover
- Diverse species blends

Partridge Pea
(Chamaecrista fasciculata)

Alfalfa
(Medicago sativa)

Oats, Peas, Clover Blend
Solarization: smothering weeds; heating soil to kill weed seeds

- Duration- 1 growing season
- 4 or 6 mil UV stabilized, *clear* high tunnel plastic (USED is great)
- Ideally no airflow, repair rips throughout season (may need deer fence)
- DO NOT TILL after removing plastic
- Not effective against some weeds
- Costly; plastic disposal issues

Photos: Sarah Foltz Jordan; Eric Mader
Various implements for trenching

Photos: Sarah Foltz Jordan
Burying the edges

Uproot Farm, Princeton, MN

Photos: Sarah Foltz Jordan
Moving a piece of plastic through an area over multiple years

Heidel Family Dairy Farm, Random Lake, WI

Photos: Sarah Foltz Jordan
Solarization- Dry Soils with Smooth Brome
Keepsake Farm, Princeton MN

June 2015 (smooth brome, hairy vetch, hoary allysum)

June 2018 (coreopsis, lupin, dotted mint, goldenrod, asters, liatris, native sunflowers, milkweeds, native sedges & grasses…….)

Photos: Sarah Foltz Jordan
Solarization: Wet Basin with Reed Canary
Open Hands Farm, Northfield, MN

Sept. 2014: regularly mowed weedy basin (reed canary, narrow-leaf cattail, some CA thistles)

Solarized 2015 (full growing season)

Seeded March 2016

Photos: Sarah Foltz Jordan
Solarization Case Study: Wet Basin with Reed Canary
Open Hands Farm, Northfield, MN

August 2018: cardinal flower, great blue lobelia, swamp milkweed, blue vervain, false aster, monkey flower, meadow rue, bur marigold, bottle gentian, brown-eyed susan…

Photos: Sarah Foltz Jordan
Solarization Case Study: Wet and Dry Soils
Prairie Drifter Farm, Litchfield, MN

Photos: Sarah Foltz Jordan & Joan Olson
Solarization of Mowed Turf
Cambridge Community Garden, Cambridge, MN

Photos: Sarah Foltz Jordan

June 2015

July 2018
Weeds Differ in their Response to Solarization

In our experience in the Upper Midwest:

**Solarization Works Well**
- Quack
- Smooth Brome
- Reed Canary
- Kentucky Bluegrass
- CA Goldenrod
- Burnet Saxifrage (carrot family)
- Yellow Bedstraw

**Solarization Hasn’t Worked Well**
- Canada Thistle
- Yellow Nutsedge
- Purslane

Photo: Sarah Foltz Jordan
Repeat Cultivation: mechanical disturbance to reduce weeds & seed bank

• Use implements with shallow depth
• Repeated throughout season
• Timing is critical
• Results variable
• Best success when weed pressure is low

Photos: Eric Mader, Alex Stone (OSU)
Repeat cultivation on former cropland
Open Hands Farm, Northfield, MN

Fall 2014

Summer 2016

2015: MOWING

Photos: Sarah Foltz Jordan, Xerces Society
Pig Rooting for Reed Canary Control
Prairie Drifter Farm, Litchfield, MN

Photos: Sarah Foltz Jordan, Joan Olson

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Pig Rooting for Reed Canary Control
Prairie Drifter Farm, Litchfield, MN

2016 Reed Canary
2017 Pig Rooting
2019 Flowering Habitat

Photos: Sarah Foltz Jordan (left), Joan Olson (center and right)
Silage Tarping / Stale Bedding
River Root Farm, Decorah, IA

Soil cultivated, irrigated or rained on, tarp laid for 3 weeks, seeds germinate but struggle, tarp removed

"Zero weed pressure through the end of the season, yep, zero" -Mike
Considerations for Species Selection

- **Native to your region**: Locally adapted species/genotypes

- **Soil Type**: Match the species habitat preferences to soil moisture conditions

- **Diversity**: Include representatives from as many plant families as possible

- Include species with **high insect value**

- Plan for **bloom succession** (pollinators need bloom all season long).

- **Aggressive species** may be helpful for resisting weed invasion

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**Table: Species Selection**

<table>
<thead>
<tr>
<th>Species/Variety</th>
<th>Bloom (Early/Mid/Late)</th>
<th>Percent of mix (by seed count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zizia atrata (Heart-leaf Golden Alexanders)</td>
<td>Early</td>
<td>3.0%</td>
</tr>
<tr>
<td>Coreopsis lanceolata (Lance-leaf Coreopsis)</td>
<td>Early-Mid</td>
<td>7.0%</td>
</tr>
<tr>
<td>Apocynum cannabinum (Dogbane)</td>
<td>Early-Mid</td>
<td>1.0%</td>
</tr>
<tr>
<td>Achillea millefolium (Common Yarrow)</td>
<td>Mid</td>
<td>6.0%</td>
</tr>
<tr>
<td>Agastache foeniculum (Purple Giant Hysop)</td>
<td>Mid</td>
<td>4.0%</td>
</tr>
<tr>
<td>Asclepias incarnata (Showy milkweed)</td>
<td>Mid</td>
<td>0.5%</td>
</tr>
<tr>
<td>Asclepias syriaca (Common milkweed)</td>
<td>Mid</td>
<td>0.5%</td>
</tr>
<tr>
<td>Asclepias tuberosa (Butterfly Milkweed)</td>
<td>Mid</td>
<td>1.0%</td>
</tr>
<tr>
<td>Asclepias verticillata (Whorled milkweed)</td>
<td>Mid</td>
<td>5.0%</td>
</tr>
<tr>
<td>Chamaecrista fasciculata (Partridge Pea)</td>
<td>Mid</td>
<td>2.0%</td>
</tr>
<tr>
<td>Dalea candida (White Prairie Clover)</td>
<td>Mid</td>
<td>3.0%</td>
</tr>
<tr>
<td>Dalea purpurea (Purple Prairie Clover)</td>
<td>Mid</td>
<td>5.0%</td>
</tr>
<tr>
<td>Echinacea angustifolia (Narrow-leaved Coneflower)</td>
<td>Mid</td>
<td>1.0%</td>
</tr>
<tr>
<td>Eryngium yuccifolium (Rattlesnake Master)</td>
<td>Mid</td>
<td>2.0%</td>
</tr>
<tr>
<td>Mentha arvensis (Wild Mint)</td>
<td>Mid</td>
<td>1.0%</td>
</tr>
<tr>
<td>Monarda fistulosa (Wild Bergamot)</td>
<td>Mid</td>
<td>2.0%</td>
</tr>
<tr>
<td>Monarda punctata (Dotted Mint)</td>
<td>Mid</td>
<td>3.0%</td>
</tr>
<tr>
<td>Potentilla arguta (Prairie Cinquefoil)</td>
<td>Mid</td>
<td>2.0%</td>
</tr>
<tr>
<td>Pyranthemum virginianum (Virginia Mountain Mint)</td>
<td>Mid</td>
<td>7.0%</td>
</tr>
<tr>
<td>Rudbeckia hirta (Black eyed susan)</td>
<td>Mid</td>
<td>1.0%</td>
</tr>
<tr>
<td>Verbena stricta (Hoary vervain)</td>
<td>Mid</td>
<td>3.0%</td>
</tr>
<tr>
<td>Helianthus annuus (Early Sunflower)</td>
<td>Mid-Late</td>
<td>3.0%</td>
</tr>
<tr>
<td>Helianthus maximilliani (Maximilian Sunflower)</td>
<td>Mid-Late</td>
<td>3.0%</td>
</tr>
<tr>
<td>Lithospermum linifolium (Tough Blazingstar)</td>
<td>Mid-Late</td>
<td>1.0%</td>
</tr>
<tr>
<td>Aster novae-angliae (New England Aster)</td>
<td>Late</td>
<td>3.0%</td>
</tr>
<tr>
<td>Aster ericoides (Heath Aster)</td>
<td>Late</td>
<td>2.0%</td>
</tr>
<tr>
<td>Solidago (Oligoneuron) rigida (Rigid goldenrod)</td>
<td>Late</td>
<td>3.0%</td>
</tr>
<tr>
<td>Solidago speciosa (Showy Goldenrod)</td>
<td>Late</td>
<td>5.0%</td>
</tr>
<tr>
<td>Koelreuteria paniculata (Prairie junegrass)</td>
<td>Late</td>
<td>5.0%</td>
</tr>
<tr>
<td>Schizachyrium scoparium (Little Bluestem)</td>
<td>Late</td>
<td>15.0%</td>
</tr>
<tr>
<td>Sporobolus heterolepis (Prairie Dropseed)</td>
<td>Late</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

**TOTALS**: 100.00%
<table>
<thead>
<tr>
<th>Starting from Seed</th>
<th>Starting from Transplants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lower Cost</strong></td>
<td><strong>Higher Cost.</strong> Can bring cost down if you are set up to grow transplants yourself</td>
</tr>
<tr>
<td><strong>More pre-planting weed control</strong> needed, since native seeds can easily get out</td>
<td><strong>Less weed control</strong> needed, since native plants will have more of a competitive</td>
</tr>
<tr>
<td>competed by weeds</td>
<td>advantage</td>
</tr>
<tr>
<td><strong>Requires mowing</strong> for weed management during establishment</td>
<td><strong>No mowing needed.</strong> Spot weeding as needed</td>
</tr>
<tr>
<td>Flowers usually not blooming/thriving until 3rd or 4th year of project (year 1:</td>
<td>Blooming flowers can be realized the 1st year of project, abundant blooms by second</td>
</tr>
<tr>
<td>weed control, year 2: mowing....)</td>
<td></td>
</tr>
<tr>
<td>Seed mix can be highly diverse (but not always realized in plant community)</td>
<td><strong>Plantings are generally lower diversity</strong></td>
</tr>
<tr>
<td><strong>Less control</strong> (design is limited to seed mix)</td>
<td><strong>More control &amp; design</strong> (desired plants can be selected, clustered, evenly distributed,</td>
</tr>
<tr>
<td></td>
<td>distributed by height, etc.)</td>
</tr>
<tr>
<td>Better for large areas</td>
<td><strong>Better for small areas</strong> (1/10 acre = 4K plants)</td>
</tr>
<tr>
<td>No irrigation needed</td>
<td><strong>May require irrigation</strong> at time of transplant &amp; dry periods</td>
</tr>
</tbody>
</table>
Plug Propagation: See Prairie Moon’s Cultural Catalog

### Germination Codes and Instructions

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>No pre-treatment necessary other than cold storage (also called dry cold stratification). Seed purchased from Prairie Moon should be stored in these conditions. Seed should germinate upon soaking in cold water.</td>
</tr>
<tr>
<td>B</td>
<td>Hot water treatment: Bring water to a boil, remove from heat, pour over seeds, and allow to cool. Leave uncovered for 24 hours prior to planting.</td>
</tr>
<tr>
<td>C</td>
<td>Stratification needed: Seeds germinate after a period of cold, moist stratification. Approximate number of days needed is indicated in the parentheses, based on germination tests in the past. Timing and conditions vary. See indoor stratification instructions for alternative methods.</td>
</tr>
</tbody>
</table>

**Stratification Sand**

We use fine sand as a medium to artificially stratify seed. We send one cup of sand which can be used to stratify up to 1/2 lb of seed (lightly more or less depending on seed size). We like this sand because, unlike other seed starting media, the uniform color and fine texture allows you to see your seed, includes drainage领先的

**Starting Seeds**

How to Grow Healthy, Productive Vegetables, Herbs, and Flowers from Seed

A succinct, compact manual containing all the basic information you need to successfully start plants from seed. This covers the fundamentals of seed selection, seed preparation, propagation, and transplanting. Includes helpful tips for successful transplanting (rudbeckia, gladiolus, and more), and a list of common transplanting tips. This book is a must-read for anyone interested in saving money, greening up with diversity, and using fewer chemicals.

**IUCN FOR FIGURES**

We include gross species/selected with figure seed and a chart. The chart includes seeds for the IUCN and other less common species. The chart includes seeds for the IUCN and other less common species. The chart includes seeds for the IUCN and other less common species.

**Dehisced**

We remove the hulls from these legume seeds.

**Hemiparasitic Species:** These species are hosts that need to be hosts to thrive. They include low-growing grasses and sedges.

**Plant Fresh Seed or Keep Moist:** Seeds will germinate until planting or starting other treatment.

**Best Planted Outdoors in the Fall:** Your input would be of interest to us.

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Photo: Karin Jokela / Xerces Society
Easy Natives to Start With:

- Agastache spp. (hyssop)
- Asclepias incarnata (swamp milkweed)
- Aster novae-angliae & others (New England aster & others)
- Coreopsis spp. (coreopsis)
- Dalea spp. (prairie clover)*
- Desmodium canadense (Canada tick trefoil)*
- Echinacea pallida (echinacea)*
- Eryngium yuccifolium (rattlesnake master)
- Eupatorium spp. (boneset, Joe Pye weed, etc)
- Helianthus spp. (native sunflowers)
- Helinium autumnale (sneezeweed)*
- Monarda spp. (bee balm, spotted bee balm)*
- Pycanthemum spp. (mountain mint)*
- Penstemon spp. (penstemon) (damp off issues)
- Solidago speciosa (showy goldenrod and others)
- Silphium spp. (compass plant, cup plant, etc)
- Verbena spp. ( vervain)
- Vernonia spp. (iron weed)

* no stratification needed

- Andropogon gerardii (big bluestem)*
- Bouteloua curtipendula (side-oats grama)*
- Bouteloua hirsuta (hairy grama) *
- Bromus kalmii (prairie brome*
- Carex brevior (plains oval sedge)
- Sporabolis sp. (prairie dropseed and others)
- Elymus spp. (wild rye & bottlebrush grass)*
- Schizachyrium scoparium (little bluestem)*
- Koeleria macrantha (june grass)*
- Panicum virgatum (Switch grass)*
- Sorghastrum nutans (Indian grass) *
- Stipa sp. (porcupine grass) *
You can choose how technical you want to get with media, containers, etc.

At Prairie Drifter Farm:

- No special soil mix—just potting soil
- Start in Open Flat (10 x 20) → transplant to individual cells

Photos: John Judson
Even if you do everything right, germination is often poor and uneven... and plant growth is slow. PLAN FOR THIS
Seeding Timing and Methods

- **Dormant seeding** is best (late fall or very early spring)
- **Divide seed** evenly into several containers
- **Mix the seed with an inert carrier** to create more volume
  - Sawdust
  - Peat moss
- **Divide area** into the same number of sections
- **Evenly distribute** seed
Seeding Methods: Lots of Good Options

Hand broadcasting

Belly-grinder

Grass-seeder

Fertilizer-spreader/PTO broadcaster

Native Seed Drills

Photos: Sarah Foltz Jordan, Jessa Guisse, Don Keirstead, Kelly Gill
Culti-packing to Increase Seed-to-Soil Contact
(following broadcast seeding, especially in Spring)

Little Hill Berry Farm, Northfield, MN

Barrel with water

Old culvert with cement

Del’s Orchard, Leonard, MN

Chain on rod

Photo: Sarah Foltz Jordan
Habitat Management: Short Term

- Regular mowing (2-3 times) in Year 1 to control annual weeds
- Ongoing mowing in Year 2 as needed
- DON’T FEEL BAD mowing flowers!

Heidel Family Dairy Farm, Random Lake, WI

Photo: Thelma Heidel-Baker
Habitat Management: Long Term

Photos: Joan Olson
We’re here to help!

- Xerces-NRCS Farm Bill Biologists across the US
- Technical & Financial Assistance Available through Farm Bill programs
- Visit Xerces Booth at MOSES
Bee Better Certified™ identifies and celebrates farmers and businesses that adopt farm management practices that support pollinators, and gives consumers confidence that their purchasing decisions benefit pollinators and the farmers working to protect them.
There are Habitat Options for Every Farm!

- Native wildflower patches
- Insectary strips
- Beetle banks
- Riparian buffers / filter strips
- Flowering hedgerows
- Understory plantings
- Cover crops
- Flowering pastures & rangeland
- Annual cut flower strips / bolting crops
- Rock piles / brush piles / bare soil for nesting

Habitat is win-win for insect conservation and farm productivity & resilience
The healing of the land and the purification of the human spirit is the same process. -Masanobu Fukuoka
Special thanks to MOSES, our farm partners, Xerces members, and supporters

OUR FARMERS:
Agua Gorda Cooperative
Blue Gate Farm
Casey Bailey Farm
Del’s Orchard
Grinnell Heritage Farm
Genuine Faux Farm
Mustard Seed Community Farm
Helgelson Farm
Heidel Family Dairy Farm
Longdale Farm
Little Hill Berry Farm
Johnson County Historic Farm
Melon Patch Herbs
Nelson Family Farm
Open Hands Farm
Prairie Drifter Farm
Paul Mugge Farm
Rabinowitz Family Farms
Scattergood Farm
Stone Creek Farm
Sogn Valley Farm
Spring Winds Farm
Taproot Farm
Uproot Farm
Vilicus Farms
Waxwing Farm
York Farm
AND MANY MORE.....

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Photo: Sarah Foltz Jordan