How Native Plant Cultivars Affect Pollinators

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Stowe, Vermont
Prairie Restoration at Earth Source, Fort Wayne, Indiana
Ohio Spiderwort
*Tradescantia ohiensis*

*Tradescantia* ‘Red Grape’
Designing with Native Species ≠ Installing Native Species
**Native Species**: A plant that is a part of the balance of nature and has developed over hundreds or thousands of years in a particular region or ecosystem.

**Native Cultivar**: A variation of a native species, deliberately selected, cross-bred or hybridized for desirable characteristics that can be maintained by propagation.
TERMINOLOGY

**Native Species**

*Synonyms:*
- species
- straight species
- true native
- wild genotype
- wild type

**Native Cultivar**

*Synonym:*
- nativar
<table>
<thead>
<tr>
<th>Native Species</th>
<th>Native Cultivars</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
</tr>
<tr>
<td>Support biodiversity</td>
<td>Unique ornamental traits (e.g. new flower or foliage color)</td>
</tr>
<tr>
<td>Preferred host plants for native insects and food source for native birds</td>
<td>Less predictable in the landscape</td>
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<tr>
<td>Adapted to local soils &amp; climate conditions</td>
<td>Less uniform and in size/shape</td>
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<tr>
<td>Promote conservation and stewardship of our natural heritage</td>
<td>Aesthetic perception that they are “too wild” and “too weedy”</td>
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<tr>
<td></td>
<td>More uniform in size/shape</td>
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<tr>
<td></td>
<td>More expensive to propagate</td>
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<tr>
<td></td>
<td>Difficulty sourcing plant material</td>
</tr>
<tr>
<td><strong>Challenges</strong></td>
<td><strong>Challenges</strong></td>
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<tr>
<td>Less predictable in the landscape</td>
<td>Lack of genetic diversity</td>
</tr>
<tr>
<td>Less uniform and in size/shape</td>
<td>May be less adapted to local soils &amp; climate</td>
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<tr>
<td>Aesthetic perception that they are “too wild” and “too weedy”</td>
<td>Decreased hardiness &amp; resiliency in the landscape</td>
</tr>
<tr>
<td>More expensive to propagate</td>
<td>May be selected for disease resistance</td>
</tr>
<tr>
<td>Difficulty sourcing plant material</td>
<td>Easier to propagate/ more profitable</td>
</tr>
</tbody>
</table>

Figure Credit: Dr. Annie White, University of Vermont, www.pollinatorgardens.org
Research Goal: Evaluate whether native plant cultivars can provide the same value to pollinators as native species in pollinator habitat restorations.
IMPORTANCE OF POLLINATORS

• **75%** - Percentage of the world’s food crops that depend at least in part on insect pollination (Klein et al. 2007)

• **90%** - Percentage of wild flowering plants that depend on animal-mediated pollination (Ollerton et al. 2011)

• **$235-577 billion** - Annual value of global crops directly affected by pollinators

• **300%** - Increase in volume of agricultural production dependent on insect pollination in the past 50 years (Aizen and Harder 2009)

• **39%** - Percentage of pollinator-dependent crop area in the U.S. that suffers from a mismatch between supply of wild bees and the need for their pollination services (Koh et al. 2016)
**Site A**
River Berry Farm  
Fairfax, Franklin County, VT  
USDA Hardiness Zone: 4B  
Soils: Excessively drained Windsor loamy fine sand

**Site B**
Maidstone Plant Farm  
Maidstone, Essex County, VT  
USDA Hardiness Zone: 4A  
Soils: Well-drained Adams loamy fine sand
EXPERIMENTAL DESIGN
Class: Insecta
Order: Hymenoptera
Super family: Apoidea

1. *Apis mellifera*
   honey bees

2. *Bombus spp.*
   bumble bees

3. other native bees

4. wasps/ants

5. Diptera
   flies

6. Coleoptera/Hemiptera
   beetles/bugs

7. Lepidoptera
   butterflies/moths

8. All pollinators

9. All bee pollinators

10. All native bee pollinators
# Bloom color, time, and duration

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<td>Rudbeckia fulgida var. fulgida</td>
<td>Black-eyed Susan</td>
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</table>

A. White, 2016
Mean pollinator abundance foraging on species/cultivars

Mean pollinator abundance reported as least squares means. Pollinator preferences between the native species and native cultivar of each plant species was determined using a generalized linear mixed model. A preference is considered significant if \( P < 0.05 \). Cells with (-) had no pollinator visits or an insufficient number of visits for analysis. Plant types with (+) in Honeybee visits indicates that the species was only at Site B and no honeybees were present in the landscape during bloom.

<table>
<thead>
<tr>
<th>Plant Type</th>
<th>All Insect Pollinators</th>
<th>All Bee Pollinators</th>
<th>All Native Bees</th>
<th>Honey Bees</th>
<th>Bumble Bees</th>
<th>Other Native Bees</th>
<th>Flies</th>
<th>Butterflies/Moths</th>
<th>Beetles/Bugs</th>
<th>Wasps/Ants</th>
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<tbody>
<tr>
<td>Asclepias tuberosa</td>
<td>14.87 ± 1.73</td>
<td>14.53 ± 1.80</td>
<td>14.53 ± 1.80</td>
<td>+</td>
<td>14.40 ± 1.71</td>
<td>0.13 ± 0.08</td>
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<tr>
<td>A. tuberosa 'Hello Yellow'</td>
<td>10.89 ± 1.40</td>
<td>10.46 ± 1.39</td>
<td>10.46 ± 1.39</td>
<td>+</td>
<td>10.30 ± 1.32</td>
<td>0.27 ± 0.15</td>
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<tr>
<td>Monarda fistulosa</td>
<td>10.28 ± 0.78</td>
<td>9.21 ± 0.78</td>
<td>9.14 ± 0.70</td>
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<td>12.73 ± 0.72</td>
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<td>M. fistulosa 'Claire Grace'</td>
<td>8.88 ± 0.67</td>
<td>7.90 ± 0.67</td>
<td>7.81 ± 0.92</td>
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<td>9.68 ± 0.58</td>
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<tr>
<td>Penstemon digitalis</td>
<td>4.85 ± 0.69</td>
<td>4.31 ± 0.62</td>
<td>3.71 ± 0.50</td>
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<td>1.35 ± 0.31</td>
<td>0.93 ± 0.23</td>
<td>2.22 ± 0.43</td>
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<tr>
<td>P. digitalis 'Husker Red'</td>
<td>3.40 ± 0.51</td>
<td>3.10 ± 0.46</td>
<td>2.93 ± 0.41</td>
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<td>0.23 ± 0.12</td>
<td>0.79 ± 0.20</td>
<td>1.56 ± 0.33</td>
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<tr>
<td>Rudbeckia fulgida var. fulgida</td>
<td>4.80 ± 0.59</td>
<td>2.94 ± 0.25</td>
<td>2.94 ± 0.25</td>
<td>+</td>
<td>0.26 ± 0.11</td>
<td>2.15 ± 0.22</td>
<td>2.34 ± 0.44</td>
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<td>R. fulgida var. suavissium 'Goldsturm'</td>
<td>5.12 ± 0.62</td>
<td>3.24 ± 0.25</td>
<td>3.22 ± 0.25</td>
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<td>0.32 ± 0.12</td>
<td>1.81 ± 0.23</td>
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<td>Veronicastrum virginicum</td>
<td>14.36 ± 1.10</td>
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<td>6.95 ± 0.79</td>
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<td>3.80 ± 0.76</td>
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<td>V. virginicum 'Lavendelturm'</td>
<td>27.35 ± 1.76</td>
<td>26.30 ± 1.45</td>
<td>19.04 ± 1.48</td>
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<td>5.60 ± 1.37</td>
<td>16.22 ± 4.45</td>
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<td>4.57 ± 2.75</td>
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<td>0.04 ± 0.37</td>
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<td>Significance</td>
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<td>P &lt; 0.001</td>
<td>P &lt; 0.001</td>
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<td>P &lt; 0.0001</td>
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<td>0.36 ± 160</td>
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<td>Agastache foeniculum</td>
<td>31.07 ± 6.06</td>
<td>23.11 ± 4.76</td>
<td>13.35 ± 2.67</td>
<td>+</td>
<td>9.03 ± 2.32</td>
<td>12.31 ± 2.29</td>
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<td>4.63 ± 1.56</td>
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<td>Agastache 'Golden Jubilee'</td>
<td>20.03 ± 4.14</td>
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<td>4.96 ± 1.30</td>
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<td>5.51 ± 0.52</td>
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<tr>
<td>B. x varicolor 'Twilite Prairieblues'</td>
<td>3.12 ± 0.32</td>
<td>3.07 ± 0.34</td>
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<td>2.89 ± 0.29</td>
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<td>15.89 ± 4.49</td>
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<td>12.85 ± 3.69</td>
<td>14.30 ± 3.21</td>
<td>0.20 ± 0.14</td>
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<td>3.53 ± 0.40</td>
<td>2.52 ± 0.37</td>
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<td>0.46 ± 0.12</td>
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<td>9.02 ± 0.56</td>
<td>28.69 ± 1.08</td>
<td>0.40 ± 0.14</td>
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<td>S. novae-angliae 'Alma Potschke'</td>
<td>4.98 ± 0.41</td>
<td>4.93 ± 0.40</td>
<td>2.92 ± 0.31</td>
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<td>Tradescantia ohiensis</td>
<td>5.35 ± 0.70</td>
<td>3.44 ± 0.61</td>
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<td>3.65 ± 0.60</td>
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<td>0.63 ± 0.14</td>
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<tr>
<td>Tradescantia 'Red Grape'</td>
<td>3.17 ± 0.40</td>
<td>1.43 ± 0.29</td>
<td>0.82 ± 0.19</td>
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<td>1.36 ± 0.26</td>
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<td>0.42 ± 0.60</td>
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</table>

**KEY:**  
- Preference for species  
- No significant preference  
- Preference for cultivar

A. White, 2016
New England Aster
*Symphyotrichum novae-angliae*

New England Aster
*S. novae-angliae ‘Alma Potschke’*
Mean abundance of pollinators foraging on native species *Symphyotrichum novae-angliae* and native cultivar *S. novae-angliae* ‘Alma Potschke’ per planting unit per 5 minutes by seven pollinator groups at Site A and Site B in 2013 and 2014 combined.
Veronicastrum Virginicum
V. virginicum ‘Lavendelturm’
## EVALUATING ECHINACEAS (Coneflower)

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Description</th>
<th>Breeder</th>
<th>Selected traits</th>
<th>Fertility</th>
<th>Bloom duration</th>
<th>floral abundance</th>
<th>Winter Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Echinacea purpurea</em></td>
<td>Native Species</td>
<td>N/A</td>
<td>None</td>
<td>high</td>
<td>30-45 days</td>
<td>20.8 ± 8.81</td>
<td>82%</td>
</tr>
<tr>
<td><em>E. purpurea</em> 'White Swan'</td>
<td>Open-pollinated selection</td>
<td>N/A</td>
<td>White ray flowers, compactness</td>
<td>high</td>
<td>30-45 days</td>
<td>12.63 ± 5.70</td>
<td>82%</td>
</tr>
<tr>
<td><em>E. purpurea</em> 'Pink Double Delight'</td>
<td>Double-flowered selection</td>
<td>AB Cultivars</td>
<td>Pink, double-flowers, many blooms, disease resistance</td>
<td>low</td>
<td>45-60 days</td>
<td>34.22 ± 10.02</td>
<td>75%</td>
</tr>
<tr>
<td><em>Echinacea 'Sunrise'</em></td>
<td>Interspecific hybrid</td>
<td>ItSaul Plants</td>
<td>Yellow ray flowers, disease resistance, compactness</td>
<td>low</td>
<td>30-45 days</td>
<td>8.62 ± 3.65</td>
<td>32%</td>
</tr>
</tbody>
</table>
Bee Pollinators Foraging on *Echinacea*

![Graph showing mean pollinator visits for different Echinacea varieties](image-url)
Research Question: Do quantity, quality, and patterns of nectar production differ between native species and native cultivars?

Handheld refractometer modified for low volumes

Disposable microcapillary tubes in 0.5 μL - 5 μL

(Comba et al. 1998; Morrant et al. 2009)
Lobelia cardinalis
Cardinal Flower
Lobelia siphilitica
Great Blue Lobelia
Lobelia x speciosa
Hybrid Lobelia

*Lobelia x speciosa* ‘Fan Scarlet’
*Lobelia x speciosa* ‘Fan Blue’
Nectar production in *Lobelia cardinalis* and *Lobelia siphilitica* vs. *Lobelia x speciosa*
Mean nectar volume in Lobelias

A. White, In Preparation
“Cardinal Flower”
*Lobelia cardinalis*
Mean nectar: 5.47 μL ±4.13

“Cardinal Flower”
*Lobelia x speciosa* ‘Fan Scarlet’
Mean nectar: 0.72 μL±0.30
HIGHLY MODIFIED
BEST FOR POLLINATORS
GOOD FOR POLLINATORS
VARIABLE VALUE TO POLLINATORS

UNMODIFIED
NATIVE SPECIES
MINIMALLY MODIFIED
MODERATELY MODIFIED
HIGHLY MODIFIED

A. White, 2016
OTHER CONCERNS WITH NATIVE CULTIVARS

- Decreased hardiness

Monarda fistulosa ‘Claire Grace’ (left) and Monarda fistulosa (right)
OTHER CONCERNS WITH NATIVE CULTIVARS

• Tissue culture and vegetative propagation yield genetically identical plants

• Decreased genetic diversity = decreased resiliency to environmental fluctuations
OTHER CONCERNS WITH NATIVE CULTIVARS

Risk of genetically polluting native species

(Van Gaal et al. 1998; Gibbs et al. 2012; Kaljund & Leht 2013)

*Lupinus perennis* (Wild Lupine)

*Plebejus melissa samuelis* (Karner Blue Butterfly)
Hardiness?

Floral abundance?

Flower size?

Flower color?

Aesthetic qualities?

Soil texture preference?

Soil fertility?

Sun exposure?

Disease resistance?

Genetic preservation?

Propagating method?

Moisture preference?

Cost?

Availability?

Insect herbivore attraction?

Pollinator attraction?

Foliage color?

Corolla width & depth?

Plant height?

Longevity?

Bloom duration?

Aggressiveness?

Nectar/pollen production?

Native Species

Native Cultivar

Native Species

Native Cultivar
Restoration Ecologist:
- herbivore attraction
- propagation method
- pollinator attraction
- genetic preservation
- conservation value

Landscape Designer:
- plant height
- aesthetics
- disease resistance
- hardiness
- longevity
- pollinator attraction
- flower color
- corolla width
- floral abundance

Pollinator:
- corolla depth
- floral abundance
- pollinator attraction
Zone 1: Urban streetscapes
Consider native cultivars for their improved tolerance of urban conditions and improved disease resistance.

Zone 2: Urban/Peri-urban parks, commercial landscapes and residential landscapes
Give priority to native species, but consider native cultivars for their improved disease resistance or to meet the aesthetic guidelines of the project.

Zone 3: Suburban to rural landscapes
Give priority to native species. Use native cultivars only when necessary.

Zone 4: Conservation areas and ecological restoration projects
Avoid native cultivars and use local ecotypes native species.