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How Native Plant Cultivars Affect Pollinators







Prairie Restoration at Earth Source, Fort Wayne, Indiana

Ohio Spiderwort Tradescantia ohiensis

Tradescantia 'Red Grape'





Designing with Native Species ≠ Installing Native Species





NATIVE SPECIES VS. NATIVE CULTIVAR

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.



Symphyotrichum novae-angliae (New England Aster) & S. novae-angliae 'Alma Potschke'

TERMINOLOGY

Native Species



Synonyms:

species straight species true native wild genotype wild type

Native Cultivar



Synonym:

nativar

BenefitsChallengesBenefitsChallengesSupport biodiversityLess predictable in the landscapeUnique ornamental traits (e.g. new flower or foliage color)Lack of genetic diversityPreferred host plants for native insects and food source for native birdsLess uniform and in size/shapeMore uniform in size/shapeMay be less adapted to local soils & climate resistanceDecreased hardiness & resiliency in the landscape	Native	Species	—) r	Native Cultivars				
Support biodiversityLess predictable in the landscapeUnique ornamental traits (e.g. new flower or foliage color)Lack of genetic diversityPreferred host plants for native insects and food source for native birdsLess uniform and in size/shapeUnique ornamental traits (e.g. new flower or foliage color)May be less adapted to local soils & climateAdapted to local soils & climateAesthetic perception that they are "too wild" and "too weedy"May be selected for disease resistanceDecreased hardiness & resiliency in the landscape	Benefits Challenges			Benefits	Challenges			
Nore expensive to propagateEasier to propagate/more profitableMay have less habitat value to pollinators and other insectsPromote conservation and stewardship of our natural heritageDifficulty sourcing plant materialDifficulty sourcing plant materialAll backsource propagateAll backsource propagate/more profitableMay have less habitat value to pollinators and other insects	Support biodiversity Preferred host plants for native insects and food source for native birds Adapted to local soils & climate conditions Promote conservation and stewardship of our natural heritage	Less predictable in the landscape Less uniform and in size/shape Aesthetic perception that they are "too wild" and "too weedy" More expensive to propagate Difficulty sourcing plant material		Unique ornamental traits (e.g. new flower or foliage color) More uniform in size/shape May be selected for disease resistance Easier to propagate/more profitable	Lack of genetic diversity May be less adapted to local soils & climate Decreased hardiness & resiliency in the landscape May have less habitat value to pollinators and other insects			

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





Achillea millefolium A. millefolium 'Strawberry Seduction'



Agastache foeniculum Agastache 'Golden Jubilee'



Aquilegia canadensis A. canadensis 'Corbett'



Asclepias tuberosa A. tuberosa 'Hello Yellow'



*Baptisia australis B. x varicolor '*Twilite' Prairieblues



Geranium maculatum G. maculatum 'Espresso'



*Helenium autumnale Helenium '*Moerheim Beauty'



Lobelia cardinalis L. cardinalis 'Fried Green Tomatoes'



Monarda fistulosa M. fistulosa 'Claire Grace'



Penstemon digitalis P. digitalis 'Husker Red'



Rudbeckia fulgida var. fulgida R. fulgida 'Goldsturm'



Tradescantia ohiensis Tradescantia 'Red Grape'



Veronicastrum Virginicum V. virginicum 'Lavendelturm'



Symphyotrichum novae-angliae S. novae-angliae 'Alma Potschke'



Echinacea purpurea E. purpurea 'White Swan'



Echinacea 'Sunrise' Big Sky Echinacea 'Pink Double Delight'



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



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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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.

		All Insect Pollinators	All Bee Pollinators	All Native Bees	Honey Bees	Bumble Bees	Other Native Bees	Flies	Butterflies/ Moths	Beetles/ Bugs	Wasps/ Ants
Selections	Asclepias tuberosa	14.87 ± 1.73	14.53 ± 1.80	14.53 ± 1.80	+	14.40 ± 1.71	-	0.13 ± 0.08	-	-	-
	A. tuberosa 'Hello Yellow'	10.89 ± 1.40	10.46 ± 1.39	10.46 ± 1.39	+	10.30 ± 1.32	-	0.27 ± 0.15			-
	Significance	P = 0.066	P = 0.057	P = 0.057	+	P = 0.0540	-	P = 0.2914	-	-	-
	Monarda fistulosa	10.28 ± 0.78	9.21 ± 0.78	9.14 ± 0.70	-	12.73 ± 0.712	-	-	-	-	-
	M. fistulosa 'Claire Grace'	8.88 ± 0.67	7.90 ± 0.67	7.81 ± 0.92	-	9.68 ± 0.58	-	-	-	-	-
	Significance	P = 0.097	P = 0.139	P = 0.152	-	P = 0.0544	-	-	-	-	-
	Penstemon digitalis	4.85 ± 0.69	4.31 ± 0.62	3.71 ± 0.50	1.35 ± 0.31	0.93 ± 0.23	2.22 ± 0.43	-	-	-	-
	P. digitalis 'Husker Red'	3.40 ± 0.51	3.10 ± 0.46	2.98 ± 0.41	0.23 ± 0.12	0.79 ± 0.20	1.56 ± 0.33	-	-	-	-
	Significance	P = 0.054	P = 0.068	P = 0.197	P = 0.0129	P = 0.4976	P = 0.1989	-	-	-	
	Rudbeckia fulgida var. fulgida	4.80 ± 0.59	2.28 ± 0.25	2.28 ± 0.25	+	0.26 ± 0.11	2.15 ± 0.22	2.34 ± 0.44	-	-	-
ĭ	R. fulgida var. sullivantii 'Goldsturm'	5.12 ± 0.62	2.34 ± 0.25	2.32 ± 0.25	+	0.32 ± 0.12	1.81 ± 0.23	2.54 ± 0.47	-	-	-
	Significance	P = 0.657	P = 0.910	P = 0.910	+	P = 0.6814	P = 0.3029	P = 0.6882	-	-	-
	Veronicastrum virginicum	14.36 ± 1.10	12.24 ± 0.93	6.95 ± 0.79	3.80 ± 0.76	5.94 ± 1.55	-	-	-	-	-
	V. virginicum 'Lavendelturm'	27.35 ± 1.76	26.30 ± 1.45	19.04 ± 1.48	5.60 ± 1.37	16.22 ± 4.45	-	-	-	-	-
Ē	Significance	P = 0.018	P = 0.011	P = 0.011	P = 0.071	P = 0.640	-	-	-	-	-
	Achillea millefolium	22.33 ± 2.74	8.81 ± 1.54	8.70 ± 1.48	-	-	8.59 ±1.09	8.39 ± 3.33	-	0.45 ± 3.93	-
	Achillea 'Strawberry Seduction'	3.17 ± 0.62	0.37 ± 0.21	0.38 ± 0.21	-	-	0.39 ± 0.11	4.57 ± 2.75		0.04 ± 0.37	-
	Significance	P < 0.001	P < 0.001	P < 0.001	-	-	P < 0.0001	P = 0.3616	-	P = 0.0019	-
	Agastache foeniculum	31.07 ± 6.06	23.11 ± 4.76	13.35 ± 2.67	9.03 ± 2.32	12.31 ± 2.29	-	-	-	4.63± 1.55	-
	Agastache 'Golden Jubilee'	20.03 ± 4.14	18.63 ± 3.88	13.30 ± 2.66	4.96 ± 1.30	11.39 ± 2.15		-		0.33 ± 0.19	-
	Significance	P = 0.041	P = 0.308	P = 0.980	P = 0.0112	P = 0.4531	-	-		P = 0.0128	-
1	Baptisia australis	7.01 ± 0.49	6.88 ± 0.52	6.88 ± 0.52	-	5.51 ± 0.52	1.30 ± 0.23	-	-	-	-
Hybrids	B. x varicolor 'Twilite Prairieblues'	3.12 ± 0.32	3.07 ± 0.34	3.07 ± 0.34	•	2.89 ± 0.29	0.15 ± 0.08			-	-
	Significance	P < 0.001	P < 0.001	P < 0.001	-	P < 0.0001	P = 0.0006	-	-	-	-
	Helenium autumnale	35.99 ± 5.07	31.17 ± 5.43	15.89 ± 4.49	12.85 ± 3.69	14.30 ± 3.21	0.20 ± 14.47	0.57 ± 0.33		-	-
	Helenium 'Moerheim Beauty'	3.53 ± 0.40	2.52 ± 0.37	2.31 ± 0.30	0.46 ± 0.12	1.21 ± 0.22	0.17 ± 12.66	0.76 ± 0.29	-	-	-
	Significance	P < 0.001	P < 0.001	P < 0.001	P < 0.0001	P < 0.0001	P = 0.6788	P = 0.6835	-	-	-
	Symphyotrichum novae-angliae	46.04 ± 1.42	43.89 ± 1.27	30.59 ± 1.04	9.02 ± 0.56	29.89 ± 1.08	0.40 ± 0.14	-	1.23 ± 0.27	-	-
	S. novae-angliae 'Alma Potschke'	4.98 ± 0.41	4.93 ± 0.40	2.92 ± 0.31	1.83 ± 0.22	2.84 ± 0.32	0.09 ± 0.05	-	0.09 ± 0.06	-	-
	Significance	P < 0.001	P < 0.001	P < 0.001	P < 0.0001	P < 0.0001	P = 0.0267	-	P = 0.0021	-	-
	Tradescantia ohiensis	5.35 ± 0.70	3.44 ± 0.61	1.71 ± 0.38	3.65 ± 0.80	2.48	2-12	0.83 ± 0.14	-	-	
	Tradescantia 'Red Grape'	3.17 ± 0.40	1.43 ± 0.29	0.82 ± 0.19	1.39 ± 0.29	-	-	0.42 ± 0.60	•	-	-
	Significance	P < 0.001	P = 0.001	P = 0.006	P = 0.0002	-	-	P = 0.8856	-	-	-

KEY:

No significant preference

Preference for cultivar



New England Aster Symphyotrichum novae-angliae New England Aster S. novae-angliae 'Alma Potschke'







Symphyotrichum novae-angliae S. novae-angliae 'Alma Poetschke' Mean abundance of pollinators foraging on native species Symphyotrichum novae-angliae and native cultivar S. novaeangliae '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)

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

Bee Pollinators Foraging on Echinacea





Research Question: Do quantity, quality, and patterns of nectar production differ between native species and native cultivars?



Disposable microcapillary tubes in 0.5 μ L - 5 μ L

Handheld refractometer modified for low volumes



(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



Lobelia cardinalis



Lobelia x speciosa 'Fan Scarlet'



Lobelia x speciosa 'Fan Blue'



Lobelia siphilitica

Mean nectar volume in Lobelias





"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



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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 propation 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)

Plebejus melissa samuelis (Karner Blue Butterfly)



Restoration Ecologist:



Landscape Designer:



Pollinator:



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.

THE ZONE APPROACH







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