Florida Native Landscaping 3815/5815C

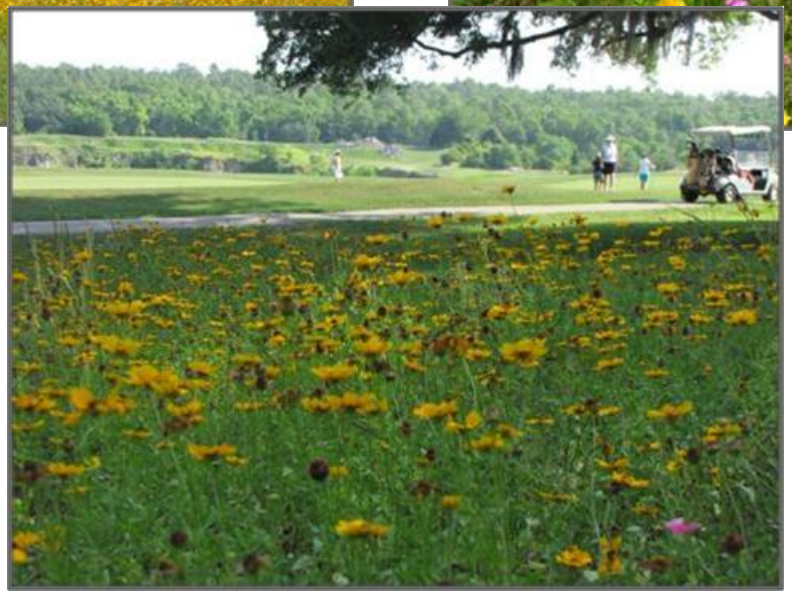
Jeff Norcini

EcoHort, LLC
Integrating ecology, biology, and horticulture

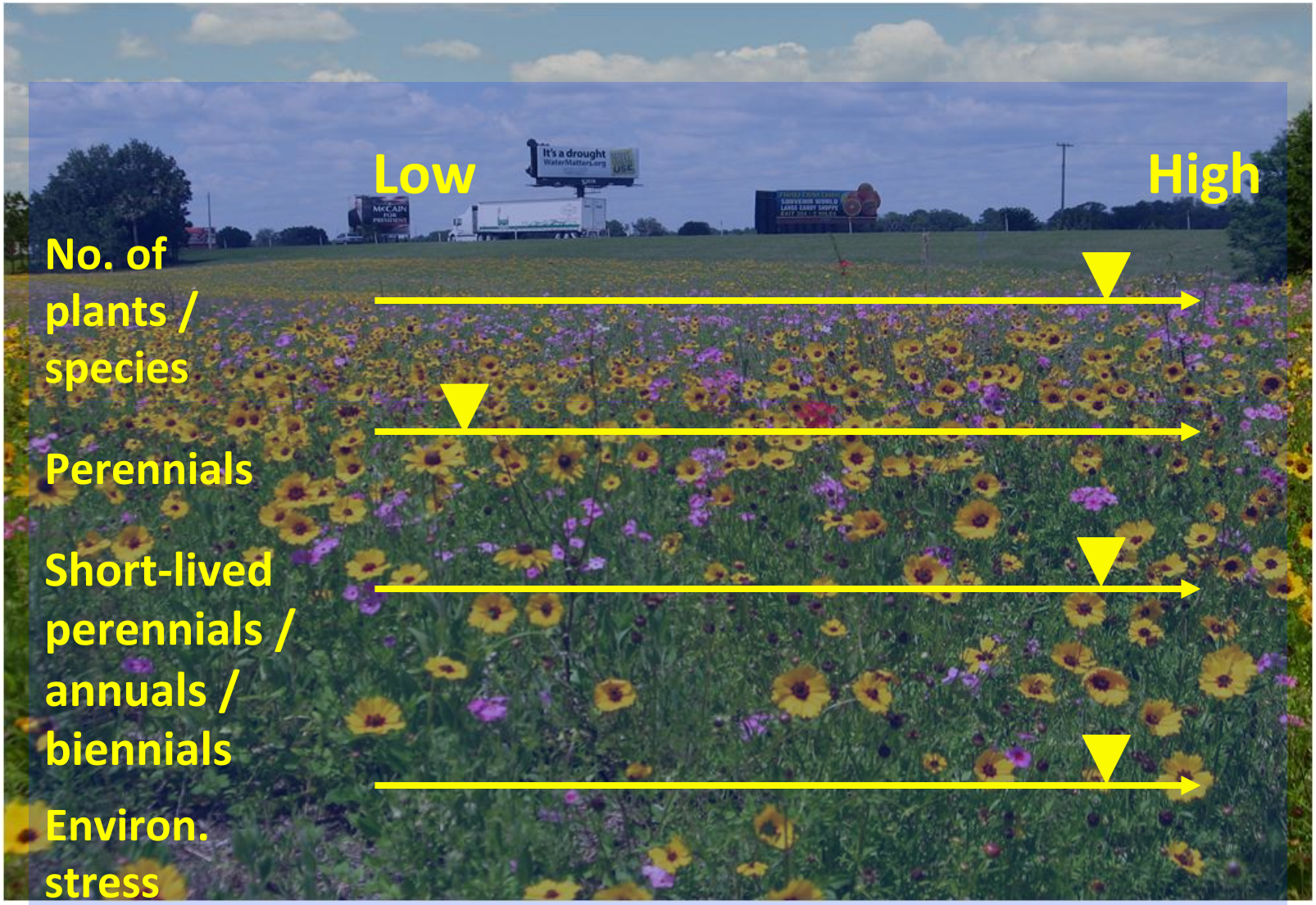
UF
UNIVERSITY of FLORIDA

Origin of the Species Matters
(*and So Does Genetic Diversity*)

Meadow, Roadside – "Reseeder"



Meadows, Roadsides



Germplasm Origin

Mass plantings (environ. stresses)

- Germplasm origin
- Genetic diversity

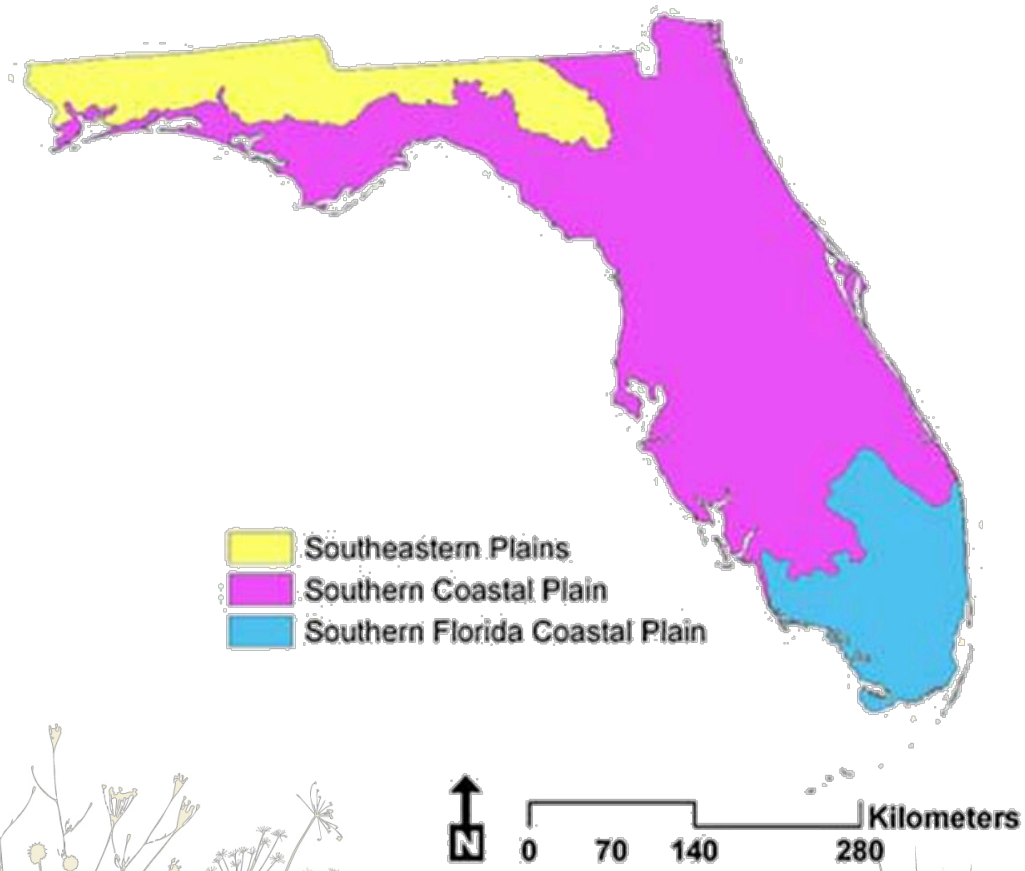
  ↑Genetic diversity → ↑sustainability

Goal – Establish a sustainable population

Ecotype

- Ecotype concept (Turesson, 1920s)
- Population of a species that's adapted to a particular set of environmental conditions
  - local or regional scale
- Occurs via natural selection

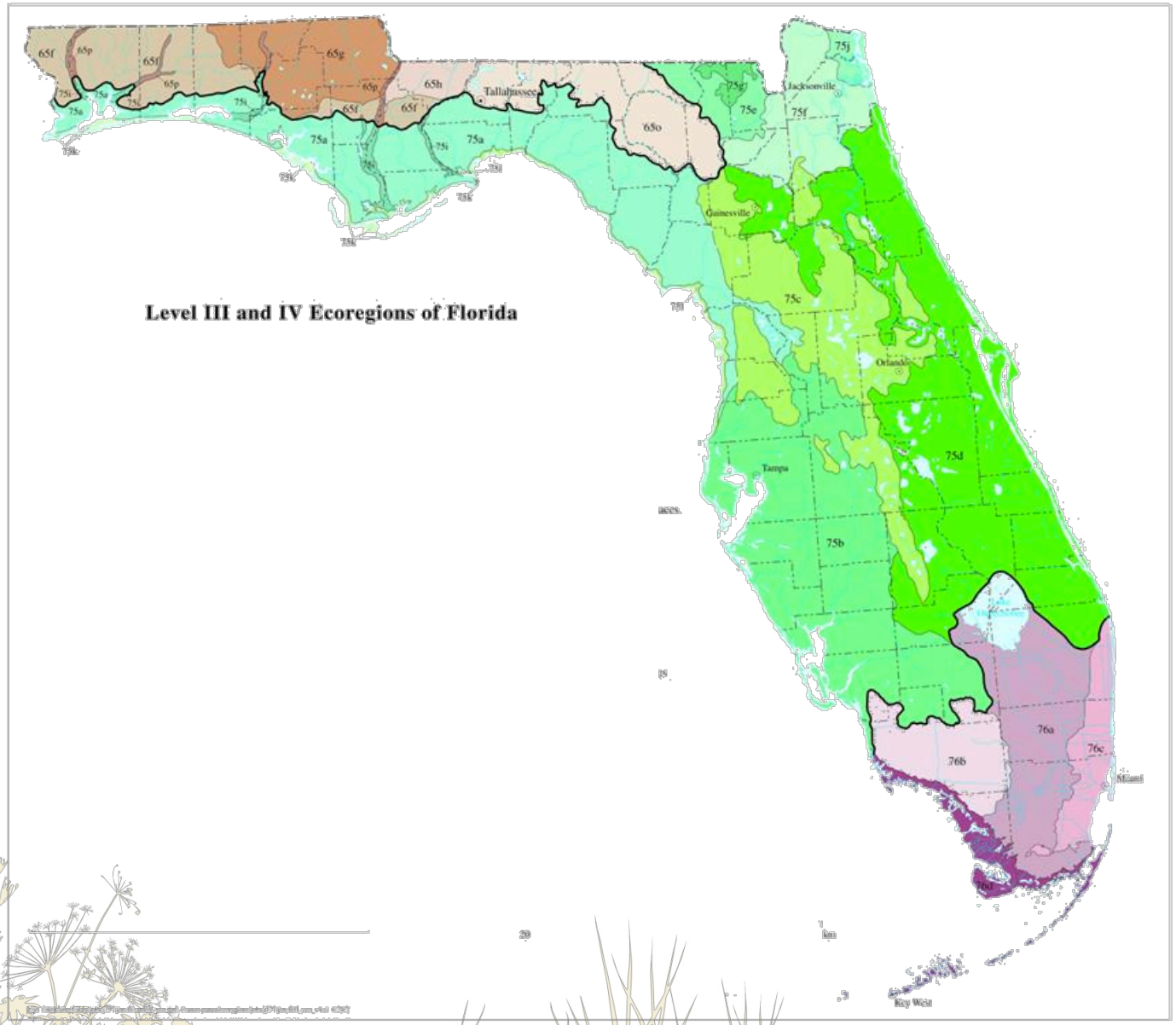
Level III Ecoregions



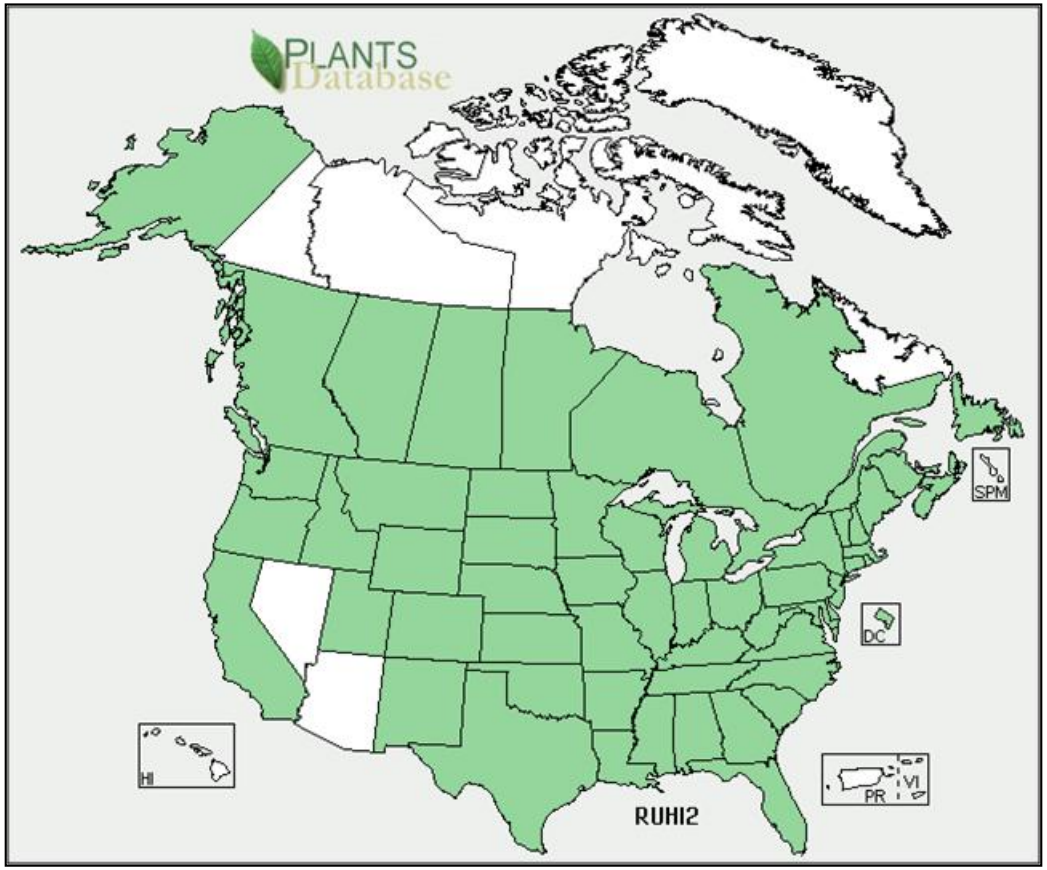
Germplasm origin

Ecoregions, not areas defined by political borders

Climate, weather, soils, hydrology, microbes, etc.


Level III and IV Ecoregions of Florida
65f
65p
65g
65h
65o
75j
75g
75e
75f
75a
75i
75c
75d
75b
76a
76b
76c
Tallahassee
Jacksonville
Gainesville
Orlando
Tampa
Miami
Key West

Rudbeckia hirta Black-eyed Susan



Rudbeckia hirta

North Florida

Texas

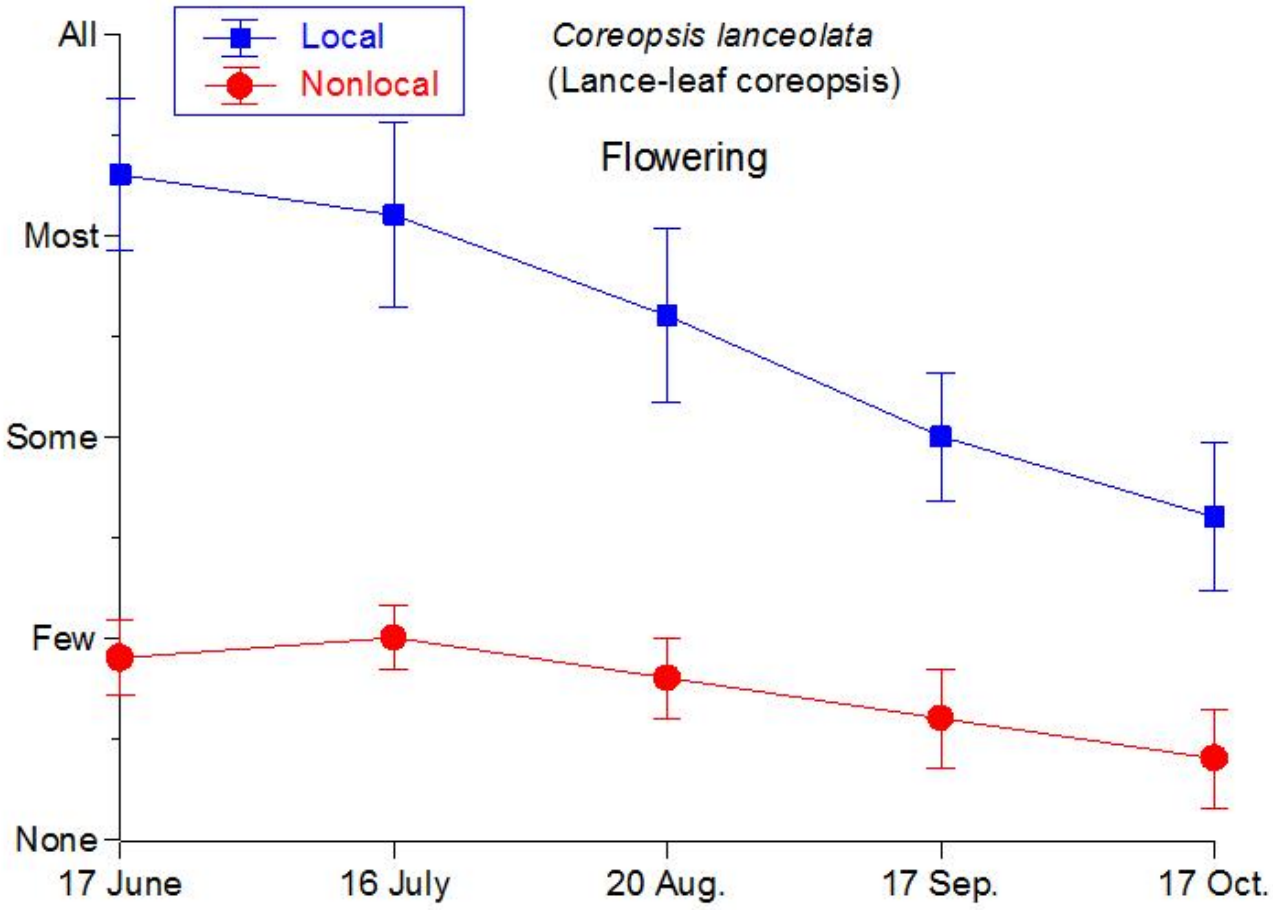
Central Florida

Rudbeckia hirta

	Percent survival under non-stress conditions (fumigated, fertilized, and irrigated)			
Germplasm	July 9	Aug. 7	Aug. 20	Sept. 3
North Florida	96	95	76	76
Central Florida	96	96	88	76
Texas	92	65	0	0

Marois and Norcini. 2003. HortTechnology 13:161-165.

Coreopsis lanceolata Lanceleaf Tickseed

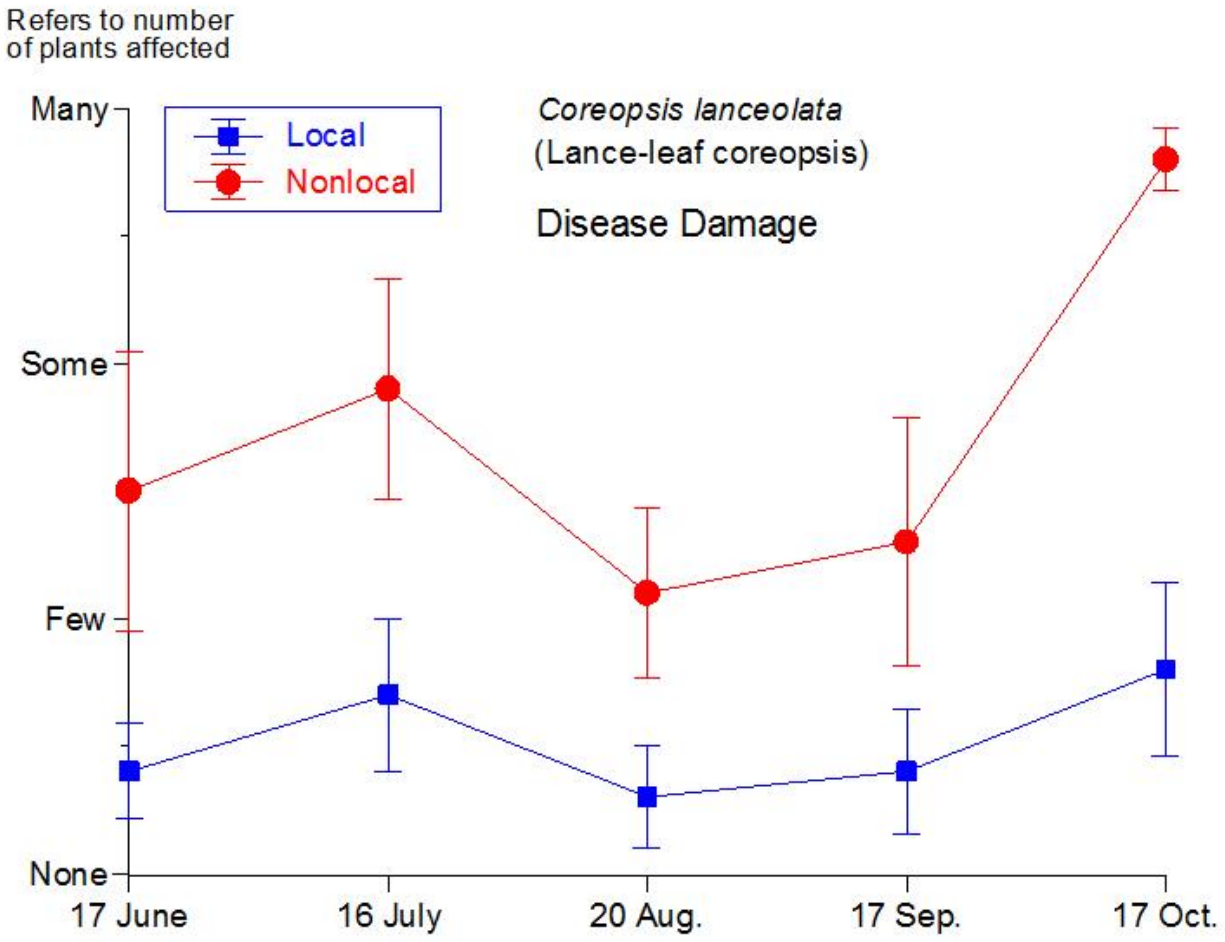


Norcini et al. 1998. Proc. of the Florida State Hort. Society 111:4-9.

Coreopsis lanceolata

North Florida ecotype (left) flowered 1st year after seeding; only sparse flowering of common garden variety (right).

Coreopsis lanceolata



Norcini et al. 1998. Proc. of the Florida State Hort. Society 111:4-9.

	Date of first flower		Date of full bloom	
	1998	1999	1998	1999
C. lanceolata/local	Apr. 9*	Apr. 7†	Apr. 16*	Apr. 18*
C. lanceolata /nonlocal	Apr. 20	Apr. 15	May 5	Apr. 30

	Date of first flower		Date of full bloom	
	1999 y	2000 y	1999	2000
S. lyrata/local	Mar. 25*	Mar. 29*	Apr. 7*	Apr. 3*
S. lyrata/nonlocal	Apr. 12	Apr. 10	Apr. 17	Apr. 15

Norcini et al. 2001. Journal of Environ. Horticulture 19:212-215.

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Norcini et al. 2001. Journal of Environ. Horticulture 19:212-215.

	% Survival	
	Feb. 1999	Nov. 1999
C. lanceolata/local	100*	31
C. lanceolata /nonlocal	86	25

	% Survival		
	)99	Nov. 1999	May 2000
S. lyrata/local		92*	89**
S. lyrata/nonlocal		72	61

Norcini et al. 2001. Journal of Environ. Horticulture 19:212-215.

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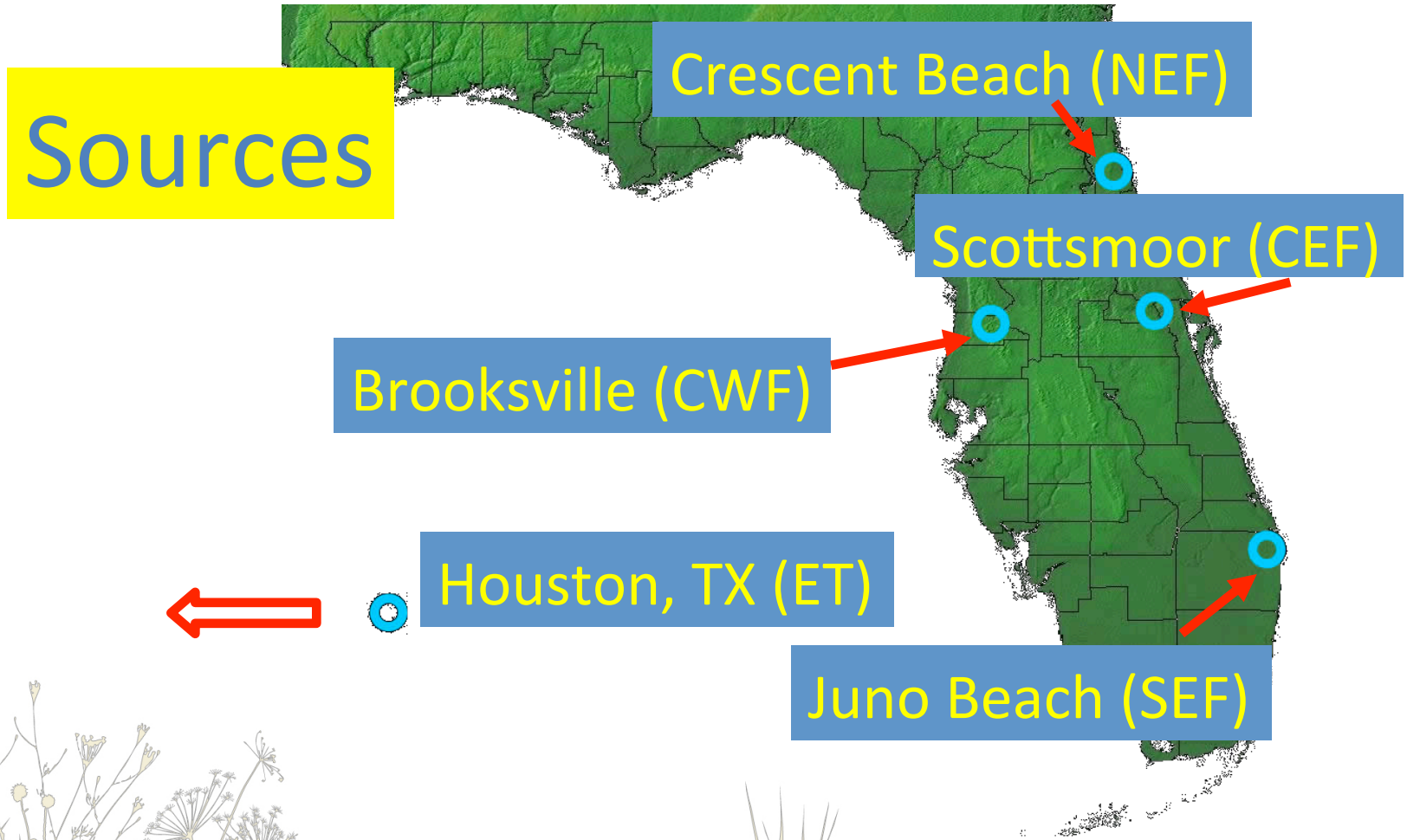
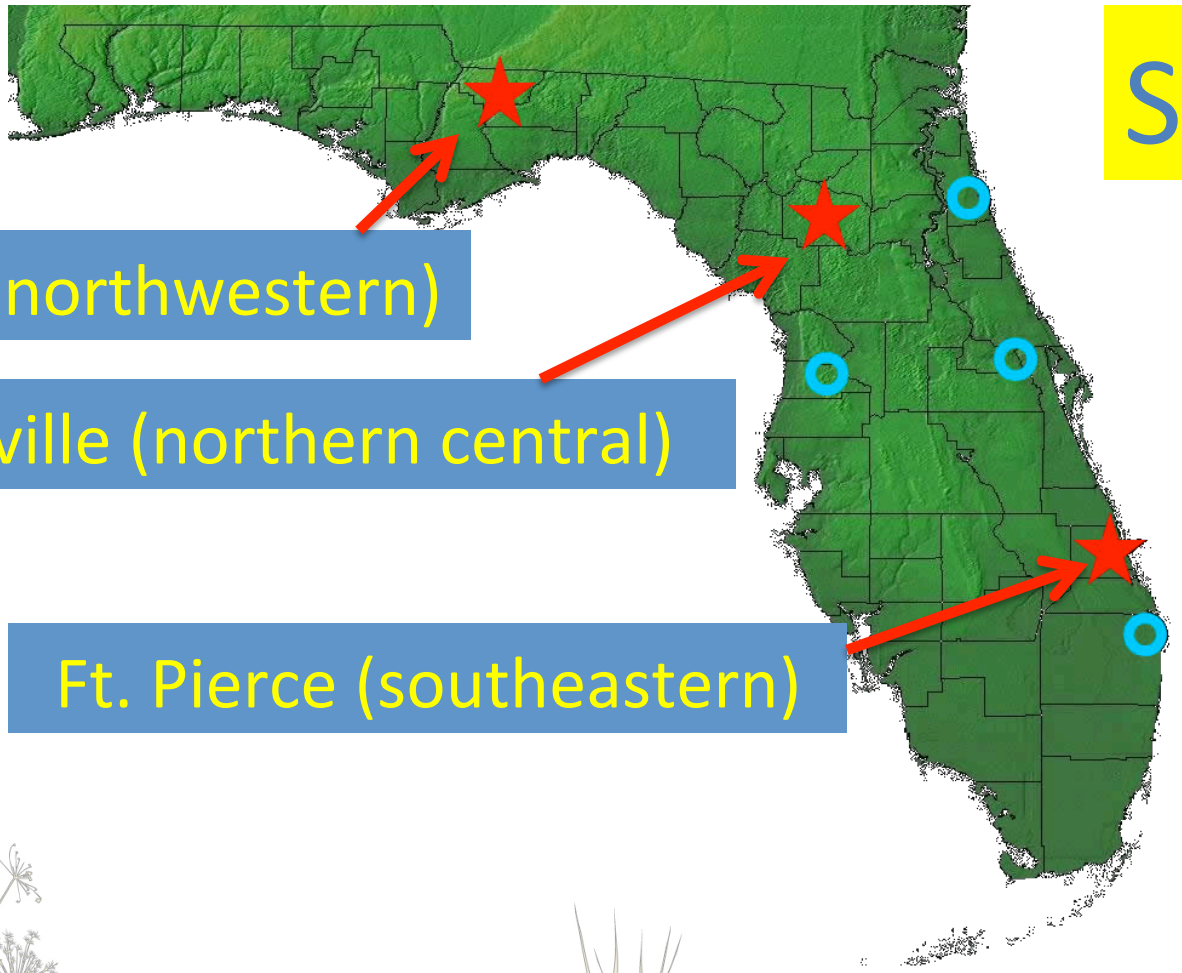
Gaillardia pulchella Blanketflower



Gaillardia pulchella



Gaillardia pulchella

		Vigor (1-3)	Flowering (0-3)	Quality (1-3)
Seed source	NEF	2.5 a	1.8 ab	2.2 a
	CWF	2.5 a	1.7 ab	2.1 b
	CEF	2.2 b	1.6 b	1.9 c
	SEF	2.5 a	1.9 a	2.1 ab
	East Texas	2.4 a	1.9 a	2.1 ab

Hammond et al. 2007. Native Plants J. 8(1):25-39.

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	SEF	2.5 a	1.9 a	2.1 ab
	East Texas	2.4 a	1.9 a	2.1 ab

Gaillardia seems to be highly adaptable, that is, a high level of phenotypic plasticity.

Aristida stricta Wiregrass

% Survival in:		C. Florida Flatwoods	N. Florida Sandhill	
Seed source		15 mo.	6 mo.	12 mo.
AP	flatwoods	86	98	95
BW	upland	57	97	88
CC	sandhills	2	---	---
OC	sandhills	42	---	---
OJ	sandhills; upland	61	96	90
PW	sand dunes	88	---	---
RS	upl./flatwoods	42	---	---
WS	sandhills	42	94	84

Kalmbacher et al. 2004. Native Plants J. 5:123-130.

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RS	upl./flatwoods	42	---	---
WS	sandhills	42	94	84

Kalmbacher et al. 2004. Native Plants J. 5:123-130.

Aristida stricta

Sandhill site in north Florida

Seed source		No. plants w/reprod. culms 0	1-5	6-10
AP	flatwoods	62	17	1
BW	clay/sand; upland	66	17	1
OJ	sandhills; upland	67	9	0
WS	sandhills	48	10	1

Kalmbacher et al. 2004. Native Plants J. 5:123-130.

Aristida stricta

Sandhill site in north Florida

Seed source		No. plants w/reprod. culms 0	1-5	6-10
AP	flatwoods	62	17	1
BW	clay/sand; upland	66	17	1
OJ	sandhills; upland	67	9	0
WS	sandhills	48	10	1

Site adaptation? Recruitment

Kalmbacher et al. 2004. Native Plants J. 5:123-130.

Aristida stricta

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Seed source		No. plants w/reprod. culms 0	1-5	6-10
AP	flatwoods	62	17	1
BW	clay/sand; upland	66	17	1
OJ	sandhills; upland	67	9	0
WS	sandhills	48	10	1

Survival, flowering – evidence for relatively high level of phenotypic plasticity

Kalmbacher et al. 2004. Native Plants J. 5:123-130.

Herbicide Tolerance

Plateau (kg ai/ha)	Blanketflower	Black-eyed susan
	Seed Source – TEX; Medium – Field Soil	
0.0175		5.0b[y]
0.035		13.3b
0.07		35.0a
0.14		36.7a
	Seed Source – NFL; Medium – Field Soil	
0.0175		0.0c
0.035		5.0b
0.07		7.5b
0.14		20.0a

Degree of injury: 0=none, 100=dead

Texas

Degree of injury: 0=none, 100=dead

N. Fla.

Norcini et al. 2003. Journal of Environ. Horticulture 21:68-72.

Herbicide Tolerance

Plateau (kg ai/ha)	Blanketflower	Black-eyed susan
	Seed Source – TEX; Medium – Field Soil	
0.0175		5.0b[y]
0.035		13.3b
0.07		35.0a
0.14		36.7a
	Seed Source – NFL; Medium – Field Soil	
0.0175		0.0c
0.035		5.0b
0.07		7.5b
0.14		20.0a

Degree of injury: 0=none, 100=dead

Texas

Degree of injury: 0=none, 100=dead

N. Fla.

Norcini et al. 2003. Journal of Environ. Horticulture 21:68-72.

Genetic Diversity

- Just as important as origin of plants or seeds
- ↑ Diversity → ↑ Sustainability

Genetic Diversity

Population of cultivar or a selection of Species X

Each letter represents 1 plant in the population

Genotypes of population – mostly ‘A’, some ‘B’ and ‘C’

A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	C	A	A	A	C	A
A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	B
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	B	A	A	A	A	B	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A
A	A	C	A	A	A	A	A	A	C	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Genetic Diversity

Population of cultivar or a selection of Species X

Each letter represents 1 plant in the population

Plants with genotype 'A' are very susceptible to drought

A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	C	A	A	A	C	A
A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	B
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	B	A	A	A	A	B	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A
A	A	C	A	A	A	A	A	A	C	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Genetic Diversity

Population of cultivar or a selection of Species X after a prolonged drought

Plants with genotype ‘A’ are very susceptible to drought

C C C B B B B C C

Genetic Diversity

Genetically diverse population of Species X

Each letter represents 1 plant in the population

Genotypes of population – ‘A’, ‘B’, ‘C’, ….’M’

A	B	A	A	A	B	A	M	M	A	M	A	A	G	A	A
A	A	L	K	C	A	C	A	A	L	C	K	L	A	C	M
I	A	C	A	A	A	A	D	A	A	A	A	A	A	A	A
C	B	A	F	D	A	A	A	A	I	A	A	I	E	F	A
A	A	A	A	A	A	C	E	A	A	M	M	M	A	A	A
F	C	M	A	M	B	A	A	M	A	A	A	A	A	A	B
G	B	A	A	A	J	C	A	F	A	A	J	A	C	D	G
G	A	A	I	A	K	A	A	A	G	A	D	H	I	A	A
A	A	A	A	A	B	A	B	A	M	B	H	A	M	J	D
E	M	A	A	A	A	A	M	A	A	B	A	A	A	K	A
A	I	A	C	D	E	H	A	C	A	A	A	I	A	A	A
H	J	A	A	A	A	A	M	I	A	A	A	A	M	A	C
A	D	A	F	A	I	A	M	B	L	A	A	J	A	K	E
A	A	E	A	M	D	A	A	A	A	M	A	A	A	K	L
G	F	C	A	A	A	G	J	K	C	A	D	A	F	A	M
D	A	A	I	A	K	A	A	A	M	A	A	I	A	A	A

Genetic Diversity

Genetically diverse population of Species X

Plants with genotype 'A' are very susceptible to drought

A	B	A	A	A	B	A	M	M	A	M	A	A	G	A	A
A	A	L	K	C	A	C	A	A	L	C	K	L	A	C	M
I	A	C	A	A	A	A	D	A	A	A	A	A	A	A	A
C	B	A	F	D	A	A	A	A	I	A	A	I	E	F	A
A	A	A	A	A	A	C	E	A	A	M	M	M	A	A	A
F	C	M	A	M	B	A	A	M	A	A	A	A	A	A	B
G	B	A	A	A	J	C	A	F	A	A	J	A	C	D	G
G	A	A	I	A	K	A	A	A	G	A	D	H	I	A	A
A	A	A	A	A	B	A	B	A	M	B	H	A	M	J	D
E	M	A	A	A	A	A	M	A	A	B	A	A	A	K	A
A	I	A	C	D	E	H	A	C	A	A	A	I	A	A	A
H	J	A	A	A	A	A	M	I	A	A	A	A	M	A	C
A	D	A	F	A	I	A	M	B	L	A	A	J	A	K	E
A	A	E	A	M	D	A	A	A	A	M	A	A	A	K	L
G	F	C	A	A	A	G	J	K	C	A	D	A	F	A	M
D	A	A	I	A	K	A	A	A	M	A	A	I	A	A	A

Genetic Diversity

Genetically diverse population of Species X after a prolonged drought

Plants with genotype ‘A’ are very susceptible to drought

	B				B		M	M		M			G		
		L	K	C		C			L	C	K	L		C	M
I		C					D								
C	B		F	D					I			I	E	F	
						C	E			M	M	M			
F	C	M		M	B			M							B
G	B				J	C		F			J		C	D	G
G			I		K				G		D	H	I		
					B		B		M	B	H		M	J	D
E	M						M			B				K	
	I		C	D	E	H		C				I			
H	J						M	I					M		C
	D		F		I		M	B	L			J		K	E
		E		M	D					M				K	L
G	F	C				G	J	K	C		D		F		M
D			I		K				M			I			

Seed Production Populations

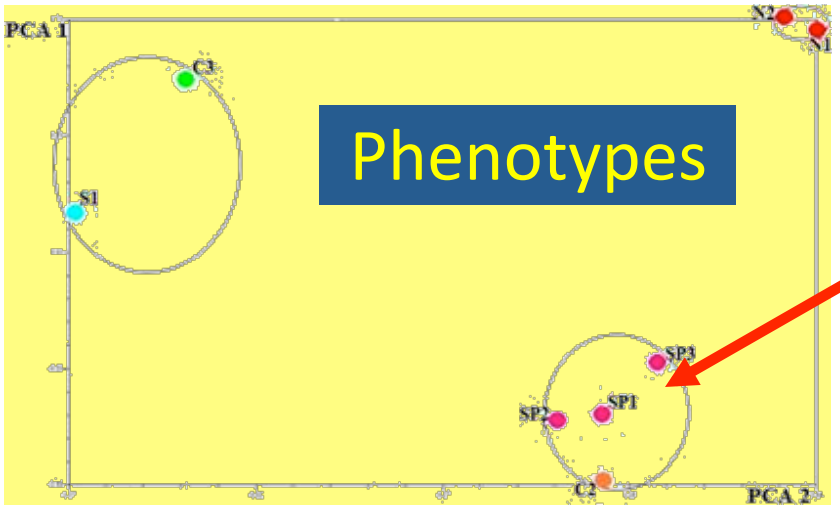
Important to maintain genetic diversity during seed production

Vacuum harvest

Seed Production Populations

- Seeds do not mature at same time
- Vacuum harvest – seeds of all plants harvested
- Capture genetic diversity of entire crop

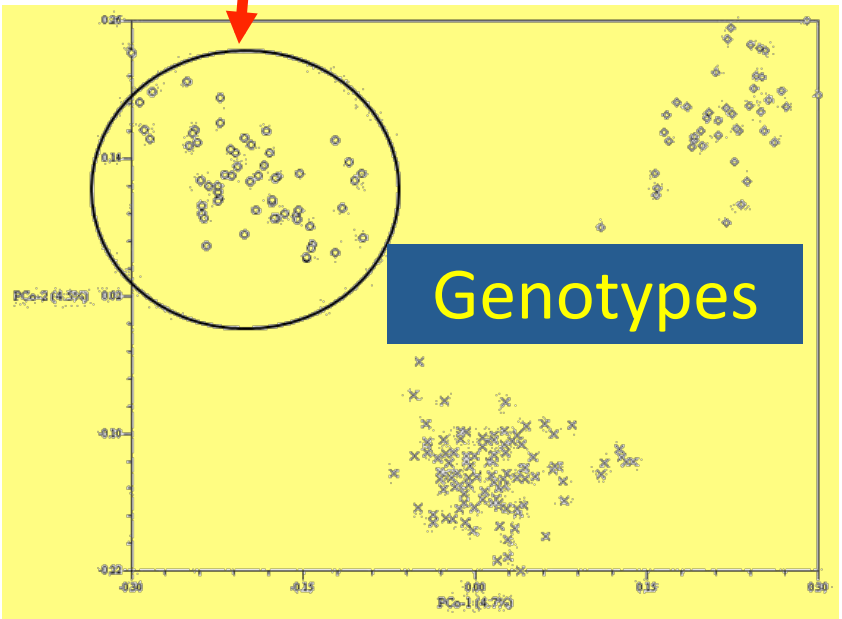
Principal Component Analyses



Phenotypes

Seed production / natural pops. clustered together

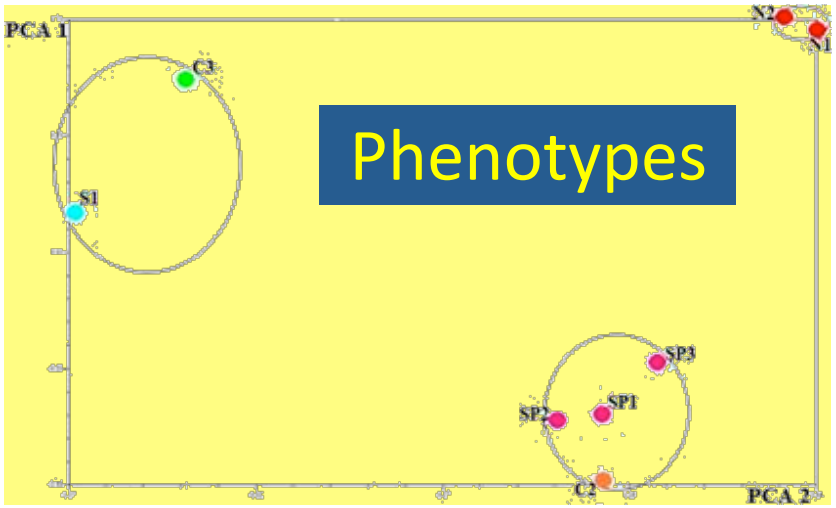
Coreopsis leavenworthii, Central Florida ecotype



Genotypes

Czarnecki et al. J. Amer. Soc. Hort. Sci. 133:234-241.

Principal Component Analyses

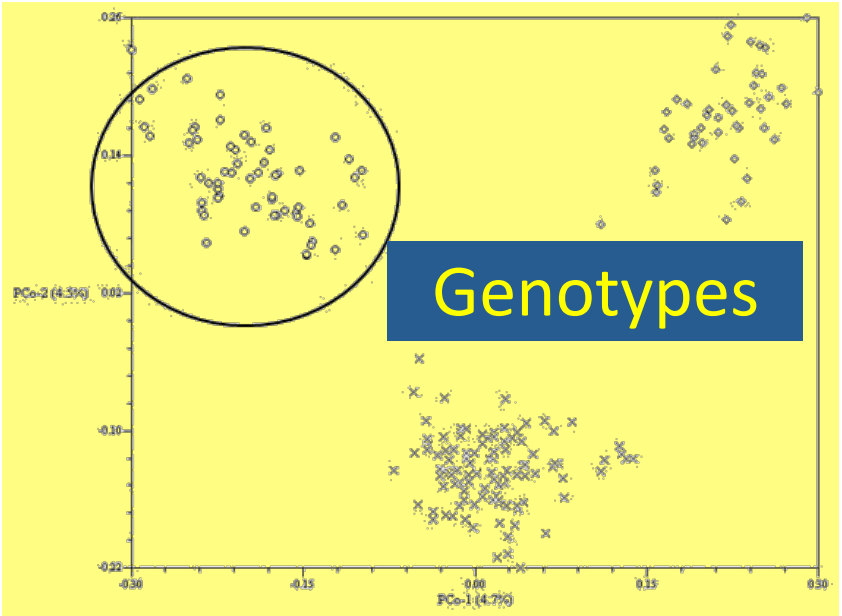


Phenotypes

Seed production / natural pops. clustered together

98% of genetic diversity preserved

Coreopsis leavenworthii, Central Florida ecotype



Genotypes

Czarnecki et al. J. Amer. Soc. Hort. Sci. 133:234-241.

Seed Production Populations

Ecotypes – Preserving genetic identity

- Rules of thumb for separation between ecotype crops*
  - Insect pollinated (forbs) – ¼ mile**
  - Wind pollinated (grasses) – 1 mile**

* Or crops of hybridizing species

** Less if natural barrier (woods)

Coreopsis leavenworthii / C. tinctoria

- Can hybridize
- *C. leavenworthii* is narrowly endemic
- Species' range overlaps by 3 counties

C. leavenworthii

C. tinctoria

Morphological Marker

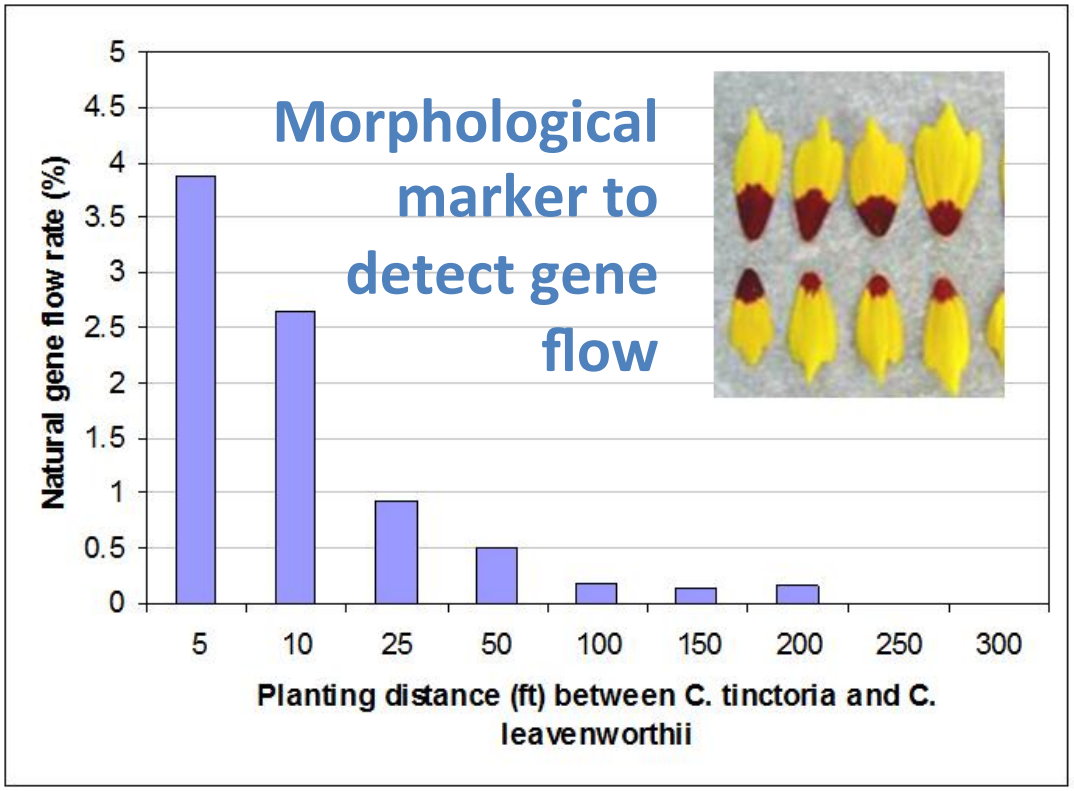
C. leavenworthii x *C. tinctoria*

Red spot (variable) at base of ray flowers used to detect gene flow

Zhanao Deng, Sarah Smith – Gulf Coast REC, Wimauma

Coreopsis leavenworthii / C. tinctoria

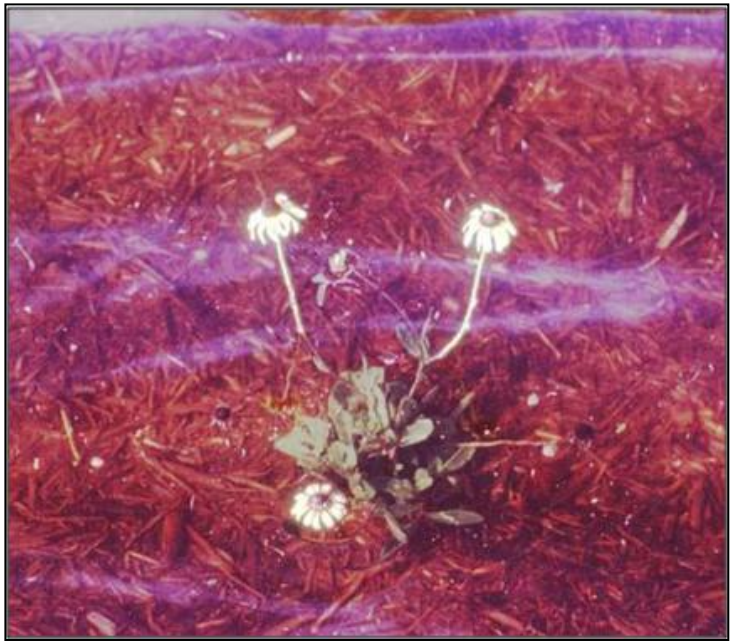
No gene flow at ≥ 250 ft



Zhanao Deng, Sarah Smith – Gulf Coast REC, Wimauma

Some food for thought.....

Rudbeckia hirta



Central Florida ecotype flowering while flooded during Sept. 1998

Professor Ary Hoffmann, an ecologist and insect expert

"Bringing Evolution into Conservation", Australasian Science, April 2010, p. 38

"When we re-establish natives in our gardens, along roadsides and in our parks, we should use plants with genes that are going to cope well with conditions in the future. By using mixtures of seeds from local areas and other locations that reflect the future environment, we create a diversity of genes upon which natural selection can act."

"Bringing Evolution into Conservation", Australasian Science, April 2010, p. 38

"… this will require a change from our current desire for genetic 'purity', avoiding mixing populations that are not connected or close."

"…promoting selection and evolution – increasing the ability of our plant and animal populations to evolve and deal with changing conditions."

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Native Wildflower Library http://flawildflowers.org/library.php

Foundation Native Flower Research http://flawildflowers.org/research.php