American Elm as a Tool in Mineland Reforestation

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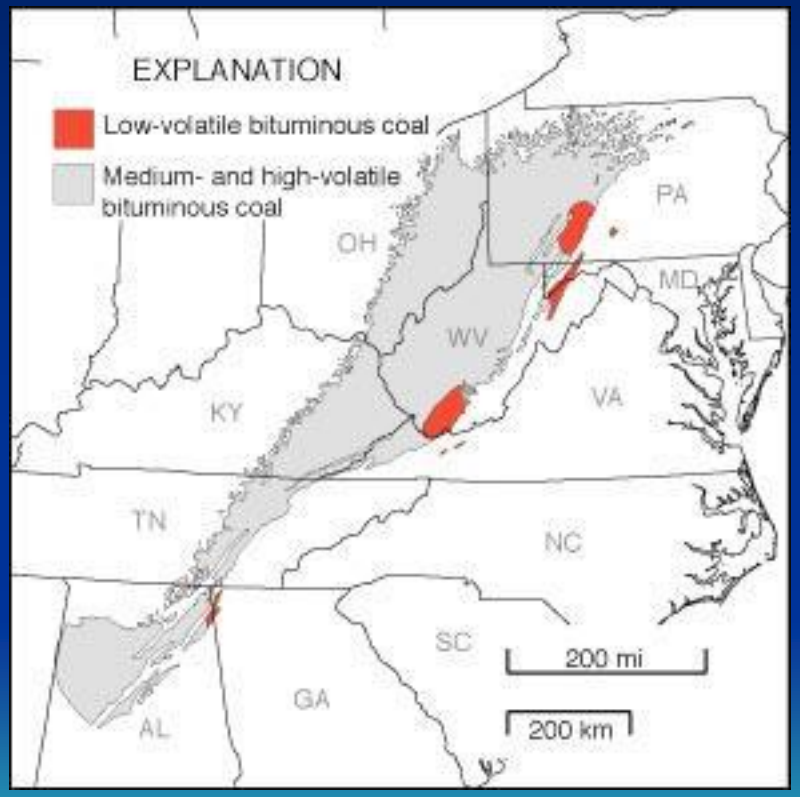


- Coalition of scientists, citizens, the coal industry and government
- Restoring forests on coal mined lands in the eastern US
- Forest Reclamation Approach (FRA)
  - Adaptive learning process
  - Sound science

Forest Reclamation Approach: **How** to achieve success

- Create a suitable rooting medium for good tree growth that is no less than 4 feet deep and comprised of topsoil, weathered sandstone and/or the best available material
- Loosely grade the topsoil or topsoil substitutes established in step one to create a non-compacted growth medium
- Use native and non-competitive ground covers that are compatible with growing trees
- **Plant two types of native trees – early succession species for wildlife and soil stability, and commercially valuable crop trees**
- Use proper tree planting techniques

Photo 4. This south-facing slope on a Tennessee mine site, photographed during its seventh growing season, was reclaimed with the FRA and planted with oaks, green ash, yellow-poplar and eastern white pine. Volunteer species including sweet birch, red maple, black gum, and black cherry also became established.

American elm

The story of American elm

- Part of several hardwood forest types
  - Elm, ash, cottonwood
  - Silver maple-American elm
  - Sycamore-sweetgum, American elm
- Bottomland forests and other forest types in Appalachia

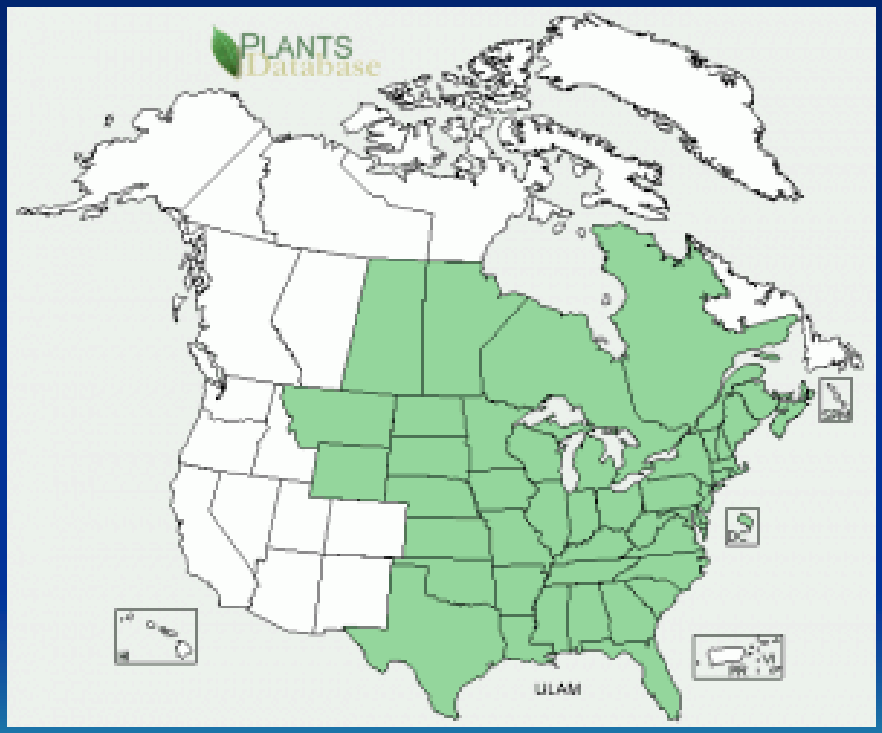
The story of American Elm

- Dutch elm disease was introduced into US in 1920s
- A fungus, moved around by bark beetle
- Nearly eliminated American elm throughout its range by 1970s

Resistant or tolerant American elms

Why elm for restoration ?

- Diversity of planting mix requires native hardwoods
- American elm – wide natural range



Why elm for restoration?

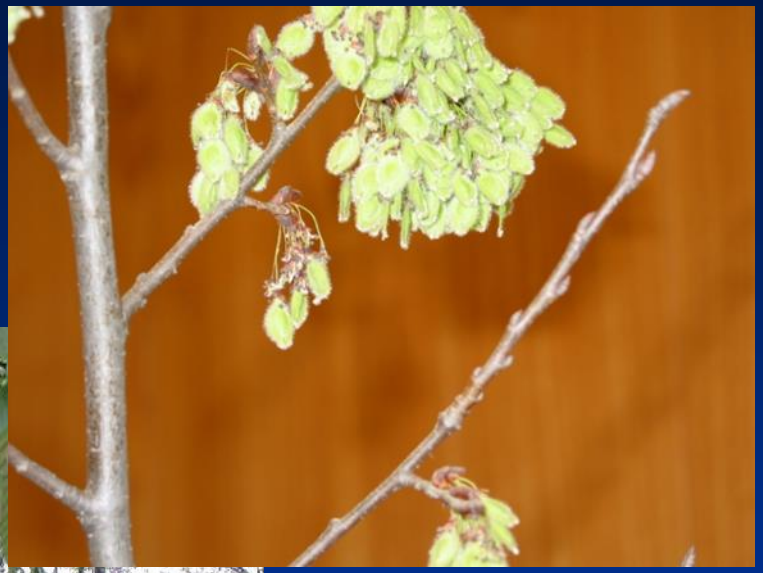
- Emerald Ash borer
  - Green ash
  - White ash

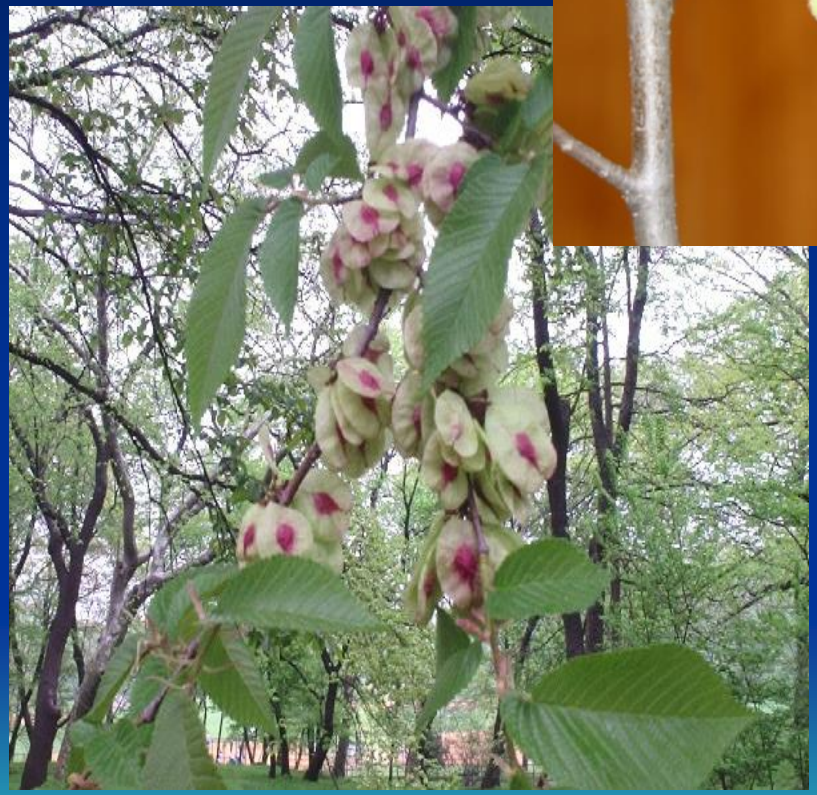
Why elm for restoration?

- Silvics similar to green ash
- “Soil improver”
  - Rapidly decomposing litter
  - Nutrient rich (high in Ca, Mg, K)
- Good roots!

- Depth of rooting varies with soil texture and soil moisture:
  - In heavy, wet soils the root system is widespread and within 3 to 4 ft of the surface.
  - On drier medium-textured soils, the roots usually penetrate 5 to 10 ft.
  - In deep, relatively dry sands in the Dakotas, taproot reached 18 to 20 ft down to the water table.

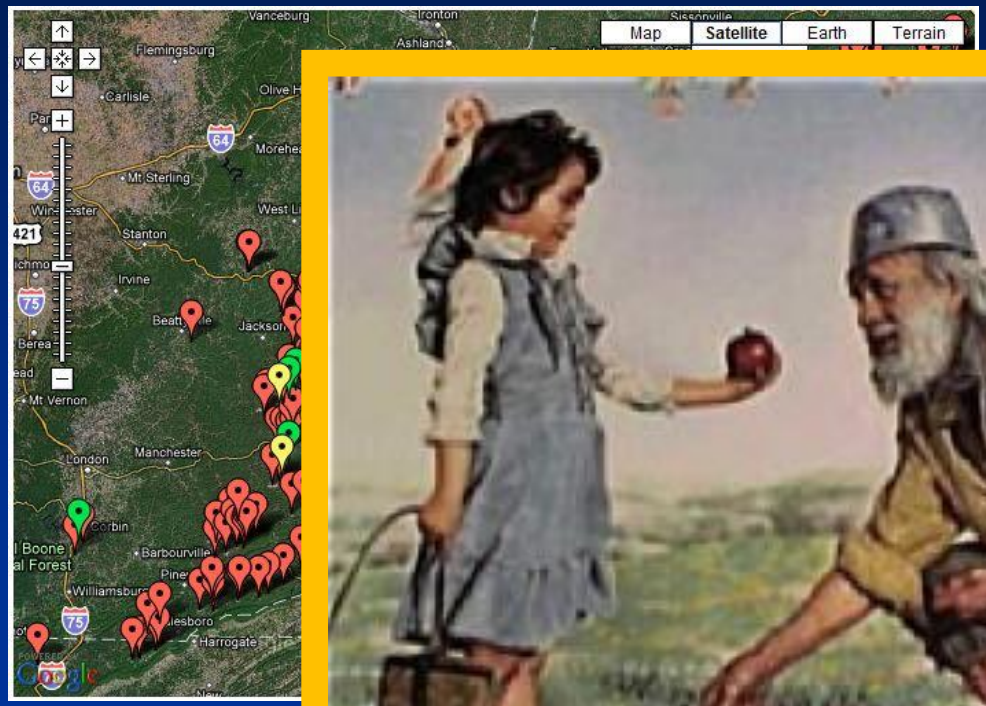
- Although American elm is common on bottom-land soils, it is found on many of the great soil groups within its range:
  - well-drained sands
  - organic bogs
  - undifferentiated silts
  - poorly drained clays
  - prairie loams,
  - many intermediate combinations.





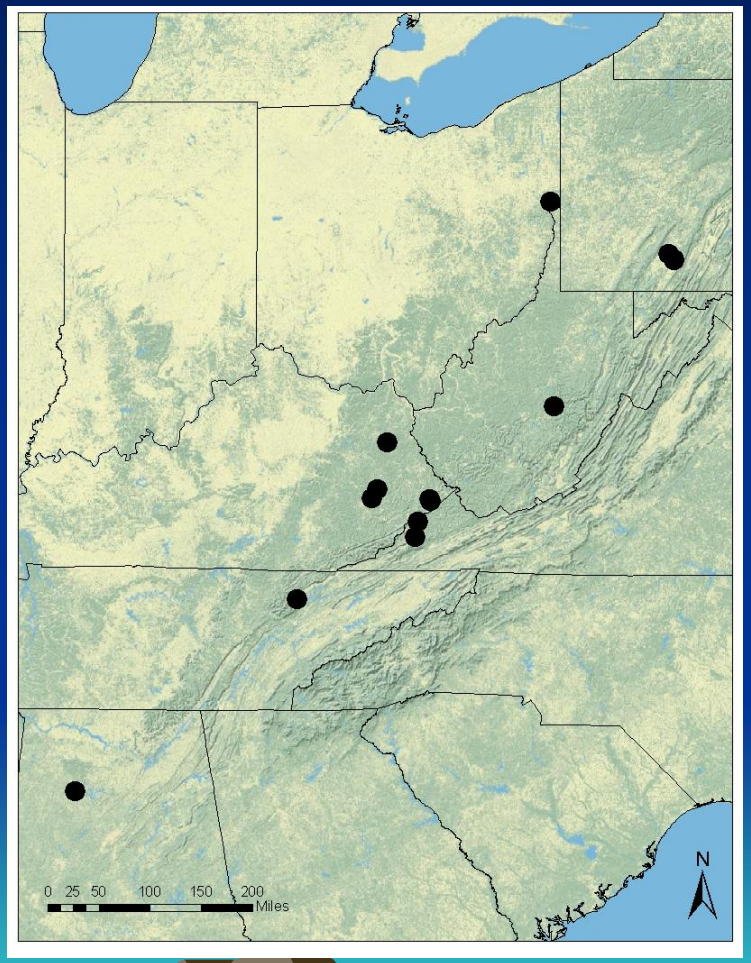
Prolific seed producer

Why elm for reforestation?



DED tolerant American Elm outplanting

- DED tolerant elms planted at 14 sites in Appalachian coal fields
- Elevations from 721-3000 ft
- reclaimed mine sites
  - FRA sites
  - Legacy sites: 1992-2005
  - AML and bond forfeiture land



Collection of American Elm Pollen and Generation of Seed in the Laboratory and Field –USDA Forest Service, Delaware, OH

Branches in Flasks

Almost Mature Seed

Fully Opened Flowers

Controlled Field Pollinations


02/16/2013


03/02/2013

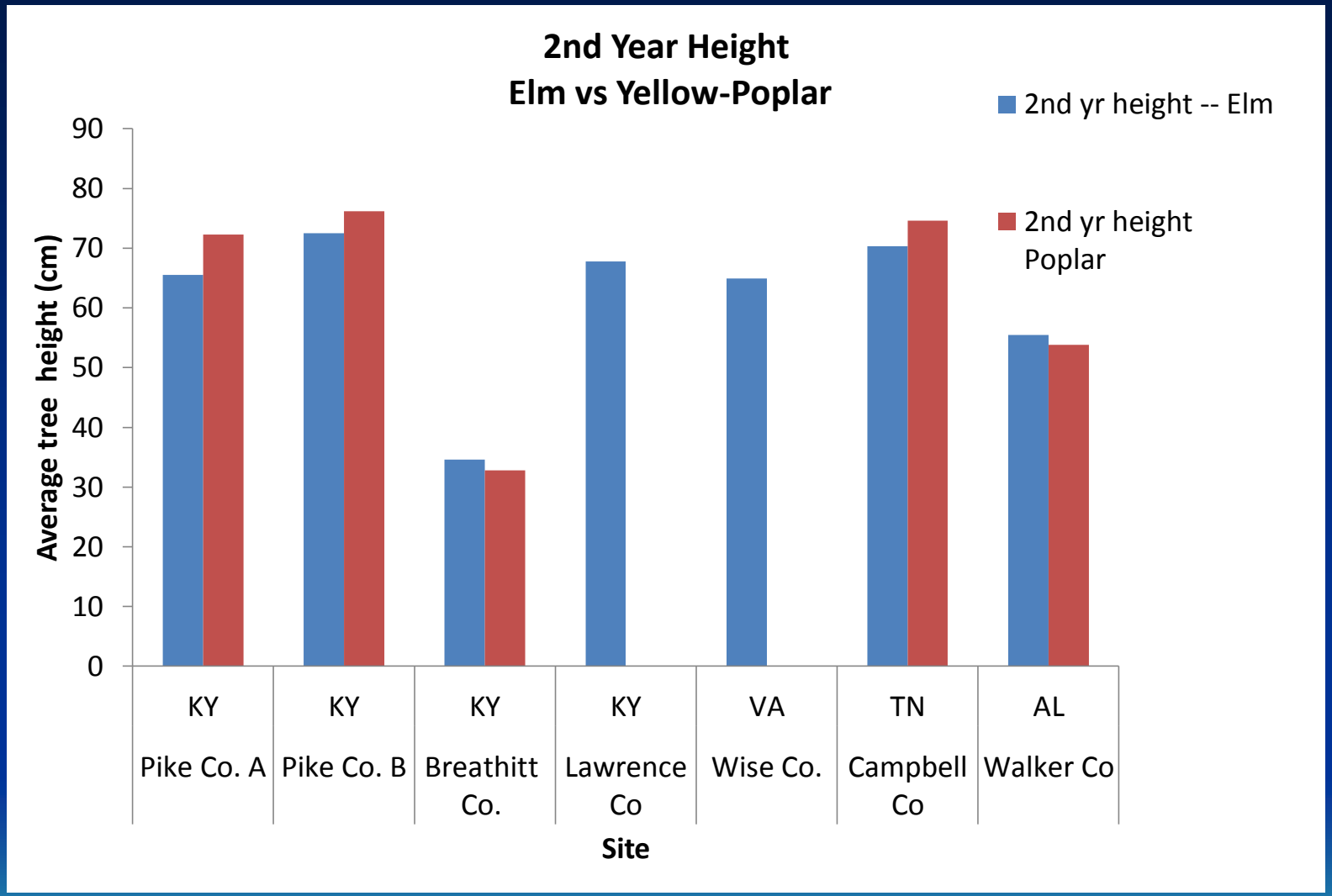

04/13/2013

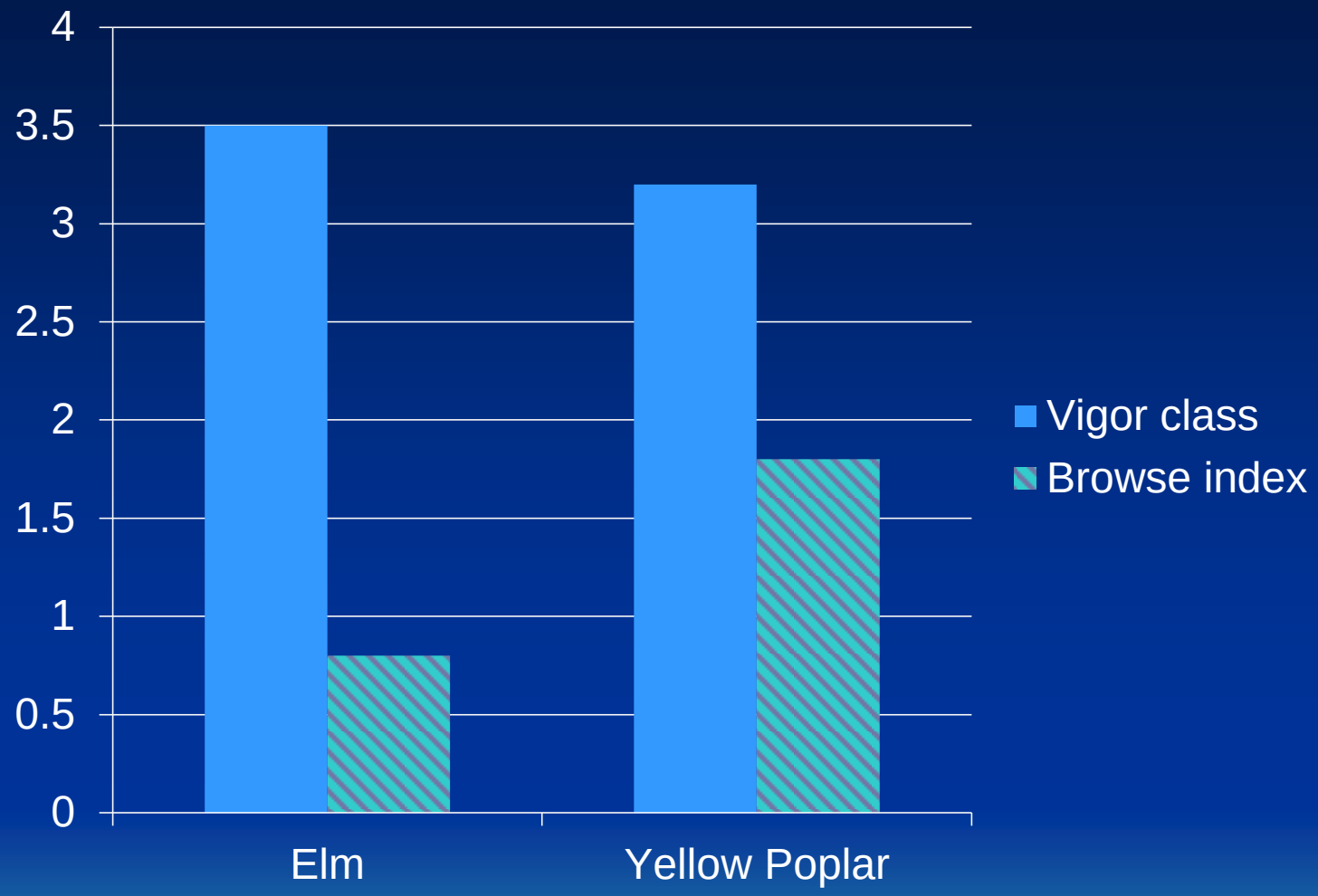
Site	State	Elev (m)	date planted	Site history		
Pike Co. A	KY	510	3/7/2013	Legacy mine site, reclaimed ~1998	ripped to 36 inches	mine spoil
Pike Co. B	KY	500	3/13/2013	Legacy mine site, reclaimed ~ 2000	ripped to 36 inches	mine spoil
Breathitt Co.	KY	420	3/24/2013	AML site	ripped to 36 inches	1/3 soil, 2//3 mine spoil
Lawrence Co	KY	460	3/28/2013	Bond forfeiture mine land, reclaimed 2012	ripped to 36 inches	mine spoil
Wise Co.	VA	556	3/27/2013	Legacy mine site, reclaimed about 1995	ripped to 36 inches	mine spoil
Campbell Co	TN	915	4/4/2013	Legacy mine site; reclaimed about 1992	ripped to 36 inches	mine spoil
Walker Co	AL	220	2/16/2013	Legacy mine site, reclaimed ~1998	ripped to 12 inches (lightly)	sandy soil

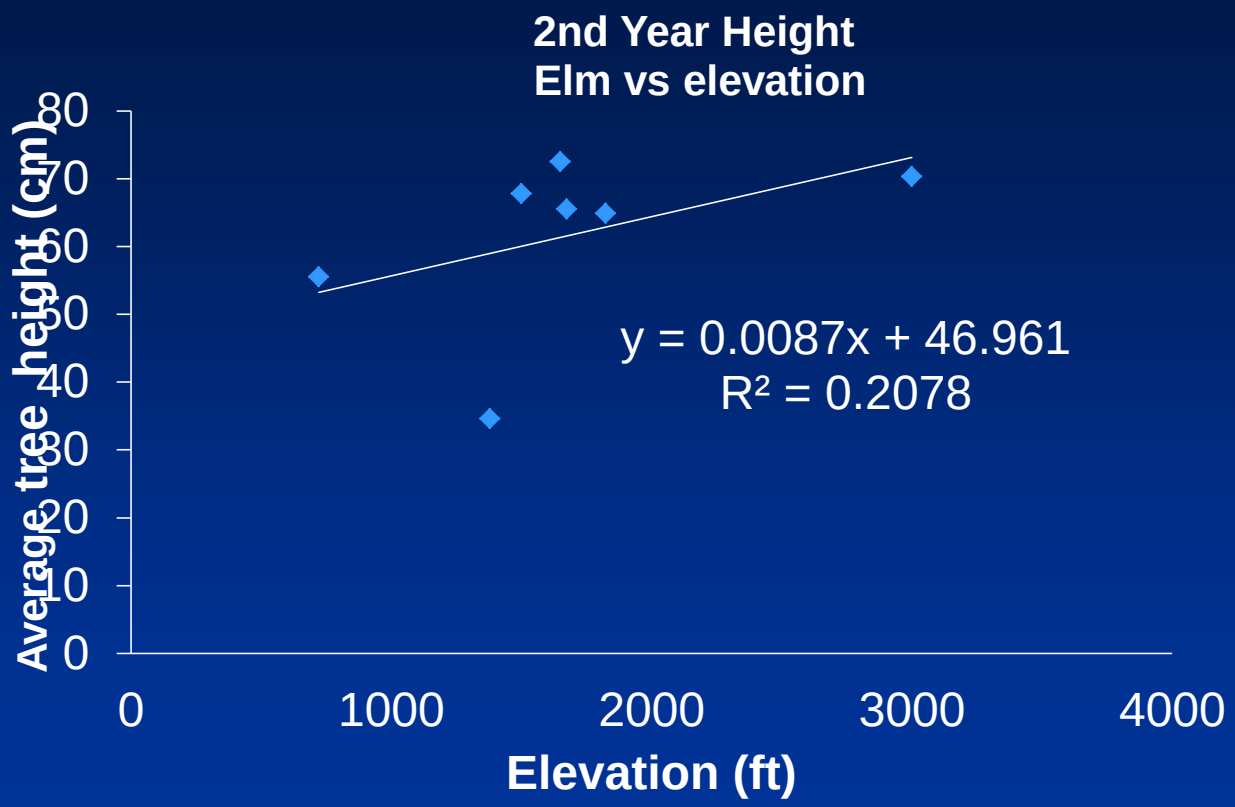
Rating	Vigor Class	Browse Class
0	Dead	No impact/no browse
1	Nearly dead	Light (1-25% of stems are browsed
2	Stressed	Moderate (26-50% of stems are browsed, seedlings not hedged
3	Little Stress	Heavy >50% of stems are browsed, seedling hedged (top greatly missing)
4	No Stress	Severe >50% of stems are browsed, seeding hedged < 6 inches tall

Planted American Elm performance after 2 growing seasons on Mine sites

SITE LOCATION	STATE	PERCENT SURVIVAL	AVERAGE HEIGHT (cm)	AVERAGE VIGOR CLASS (0-4)	AVERAGE BROWSE (0-4)
PIKE CO. A	KY	78	65.5	3.7	0.3
PIKE CO. B	KY	82	72.5	3.0	0.5
BREATHITT CO.	KY	65	34.6	3.0	2.2
LAWRENCE CO.	KY	75	67.8	3.9	1.3
WISE CO.	VA	80	64.9	3.6	0.2
CAMPBELL CO.	TN	80	70.3	3.9	0.2
WALKER CO.	AL	78	55.5	3.7	1.0
Average of all site locations		77	61.6	3.5	0.8


2nd Year Height
Elm vs Yellow-Poplar
2nd yr height -- Elm
2nd yr height Poplar
Average tree height (cm)
90
80
70
60
50
40
30
20
10
0
KY
Pike Co. A
KY
Pike Co. B
KY
Breathitt Co.
KY
Lawrence Co
VA
Wise Co.
TN
Campbell Co
AL
Walker Co
Site


4
3.5
3
2.5
2
1.5
1
0.5
0
Elm
Yellow Poplar
Vigor class
Browse index


2nd Year Height
Elm vs elevation
Average tree height (cm)
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
Elevation (ft)
y = 0.0087x + 46.961
R² = 0.2078

Summary

- After 2 growing seasons, DED-tolerant American elm survival and height growth was good to very good across a wide geographic range.
- American elm performed similarly to yellow-poplar in terms of growth over 2 growing seasons.
- DED- tolerant American elm could be an important part of the planting mix for mineland reforestation.

- Assessment of long-term performance is needed
- Assessment across geography is needed.
- Availability of sufficient seedlings of DED-tolerant American elm is an issue.
- More information is needed re: genetics
- More information on ecosystem function related to American elm is needed.

Think Big

Based on what we learn from mined land reforestation :**Is DED-tolerant American elm a good "tool" (or one of our good tools) for restoration of dramatically disturbed lands?**