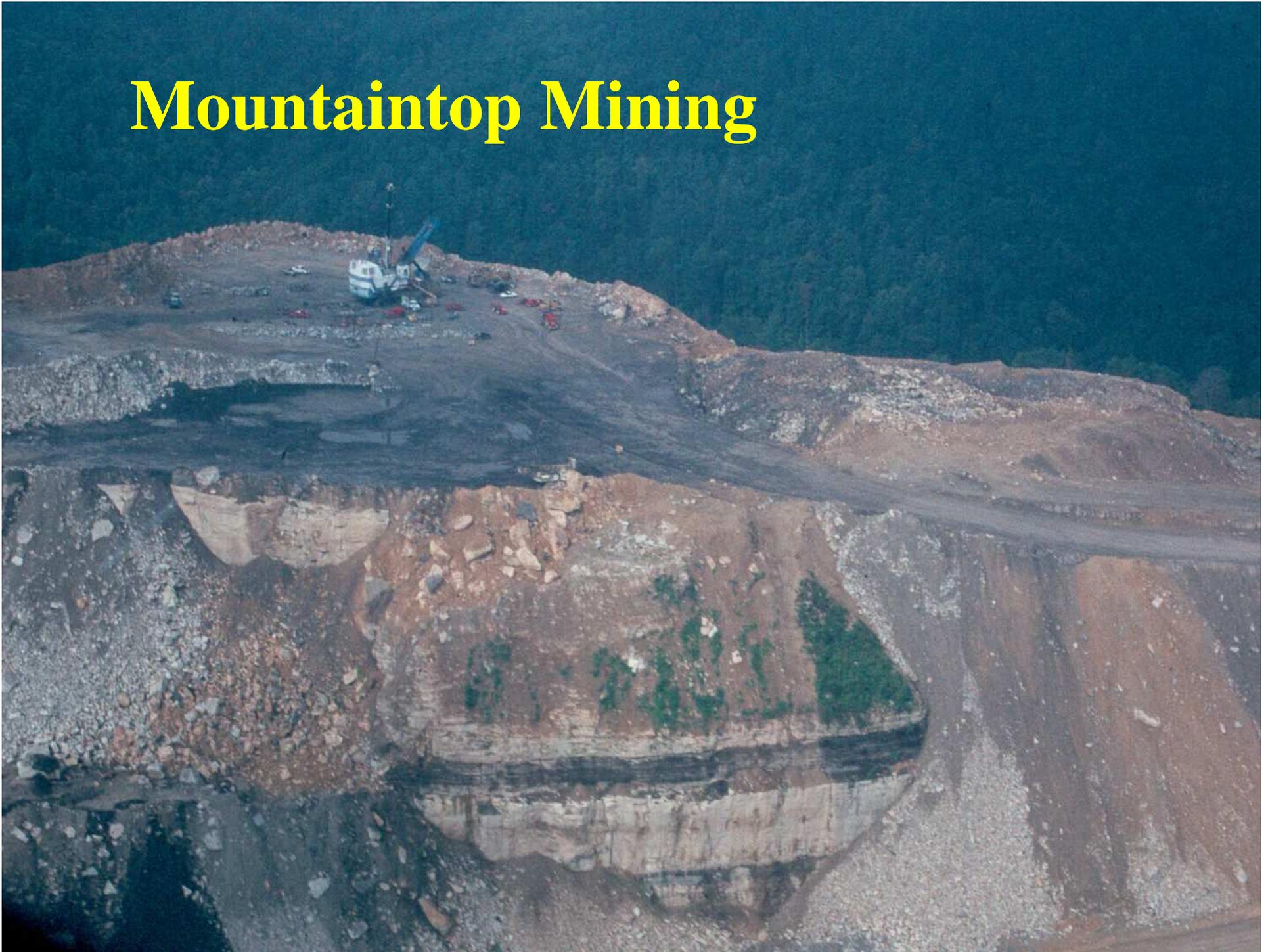


**SEED COLONIZATION  
OF FIVE HARDWOODS  
ON RECLAIMED LAND:  
7<sup>th</sup> YEAR RESULTS**

**Jeff Skousen et al.  
WVU**

**2006 8 1**

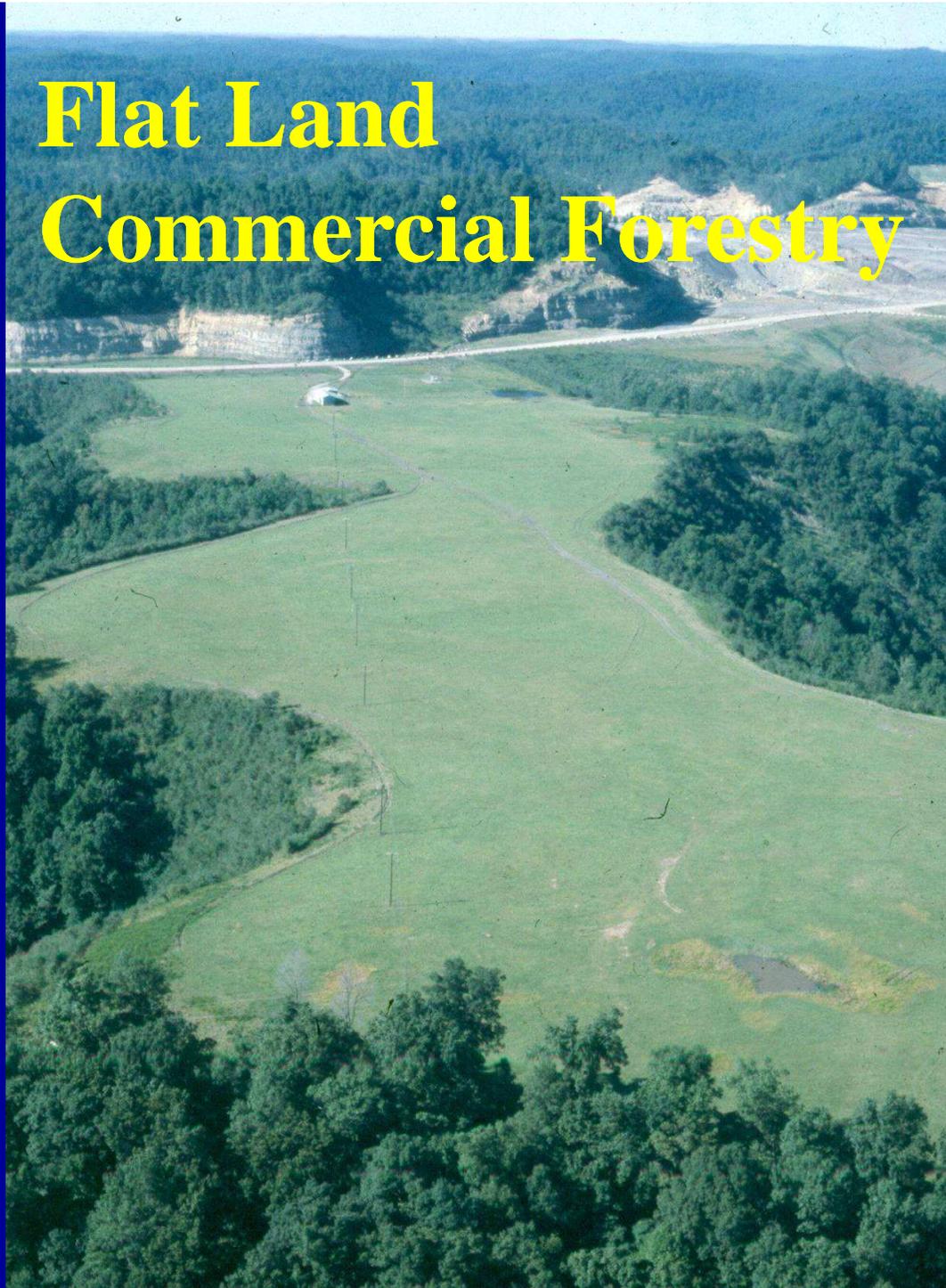
# Mountaintop Mining



A wide-angle photograph of a large-scale open-pit mine. The mine is characterized by multiple horizontal layers of earth and rock, showing a stepped profile. In the foreground, a large yellow dump truck is parked on a dirt road. The background features a dense forest of trees on a hillside under a clear blue sky. The overall scene depicts a significant industrial mining operation.

**With an AOC variance (flatter land),  
then commercial forestry  
is the post-mining land use!**

# Flat Land Commercial Forestry





# Eastern Deciduous Forest

# Beautiful and Diverse Ecosystem



# Reclamation to pasture and hay land



# Productive post-mining farm uses





**PASTURE AND HAY**  
**POST-MINING LAND**

**Fast economic return**

**Less expensive**

**Less erosion**

**Little diversity**

**Long-term land use**

**But what about the pre-mining land use?**

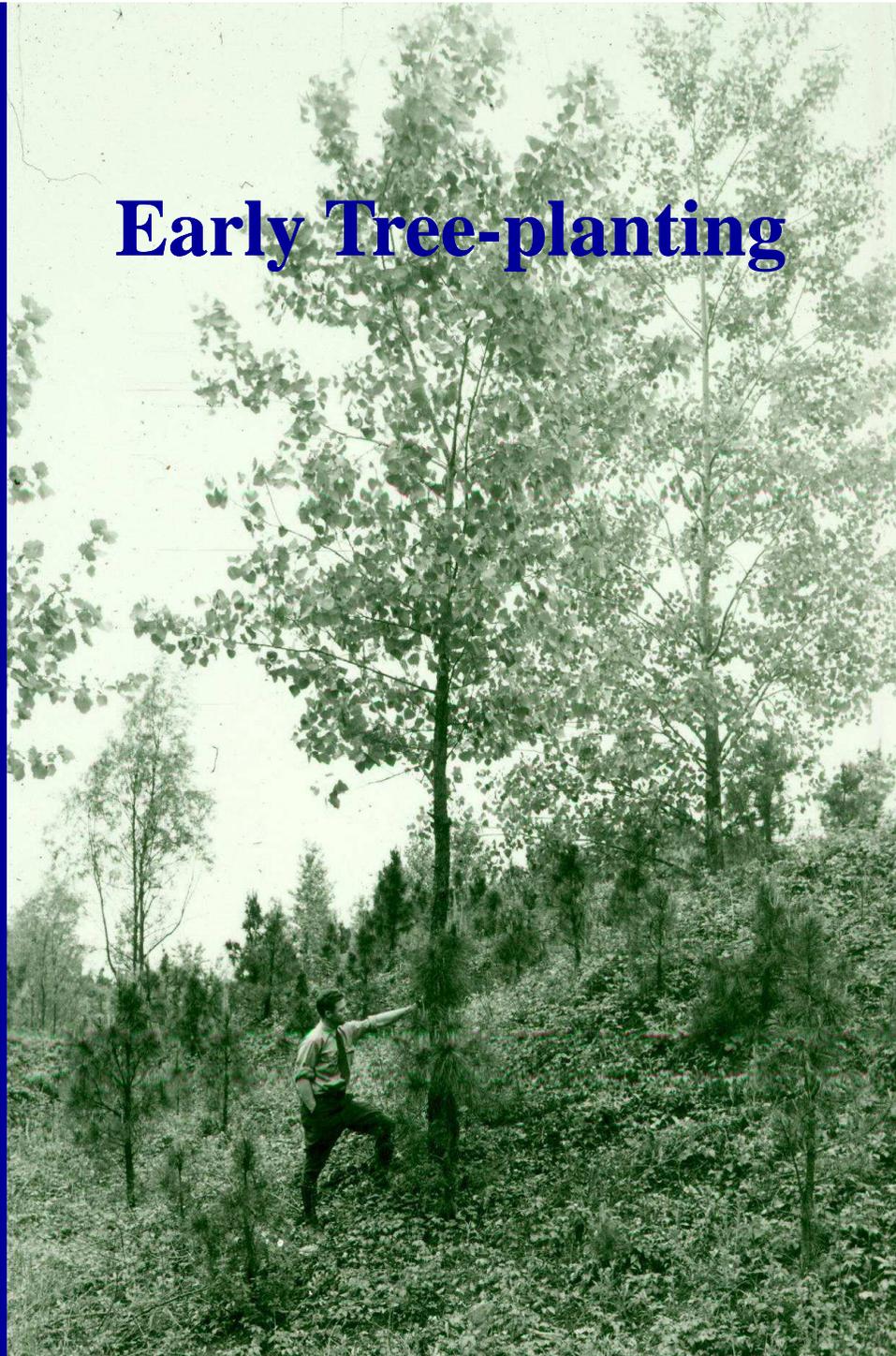


# Tree Planting in 1940s

- uncompacted spoils
- no seeding or competition



# Early Tree-planting





**Trees a better alternative**

A photograph of a forest with a person standing among trees for scale. The forest floor is covered in fallen leaves, and the trees are tall and thin. The text is overlaid on the image in yellow.

# FOREST POSTMINING LAND

**Long-term site stability**

**Inhibit invasive species**

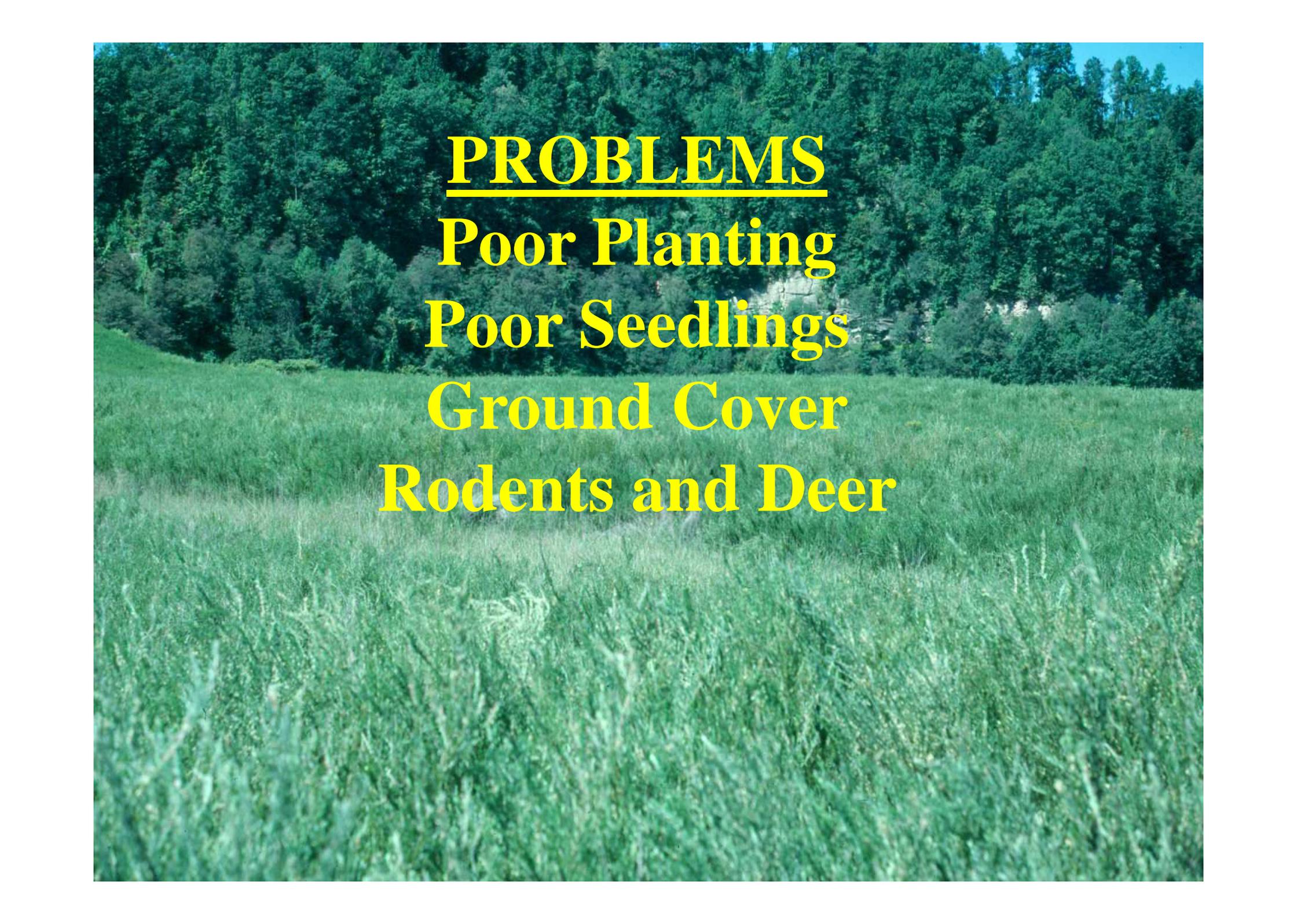
**Wildlife habitat**

**Timber Sales**

**PROBLEMS**  
**Soil Properties**  
**Compaction**  
**Aspect**

AUG 21 2003





**PROBLEMS**  
**Poor Planting**  
**Poor Seedlings**  
**Ground Cover**  
**Rodents and Deer**

# Failure of tree planting on poor soils!





**Help Operators  
Put Trees Back on Prepared Sites!**

2005 3 24

# OBJECTIVE

**Establishment and Growth  
of 5 hardwood trees:**

- north and south aspects
  - ripped and unripped
  - mowed and unmowed
  - seedlings and seeds

# SITE

**1-year-old reclaimed site**

**75% SS and 25% Shale**

**15 cm FBC Ash**

**15-30 cm Topsoil**

**Fertilized**

**Wheat, Tall Fescue, Trefoil**

# Ash Placement and Topsoil



# Reclaimed Pasture Area

Four Sites of 0.25 ha each  
North Aspect Mowed  
North Aspect Unmowed  
South Aspect Mowed  
South Aspect Unmowed

Dense Herbaceous Cover

South Aspect

North Aspect – across road



**One site on each aspect was Mowed**  
**5 July 2001**



# Ripping with Blade



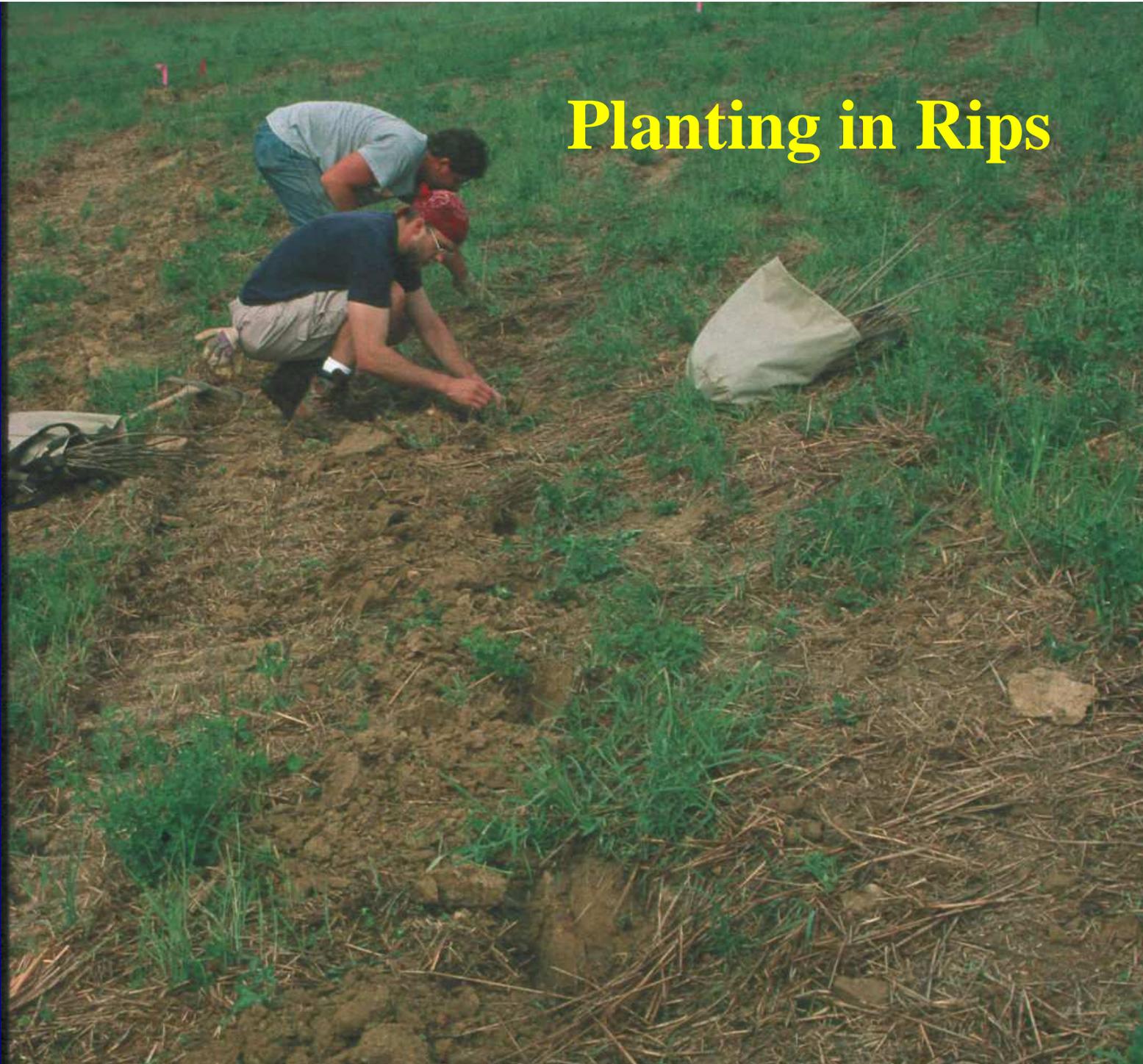
**Ripping Along Contour – 30 inches deep**

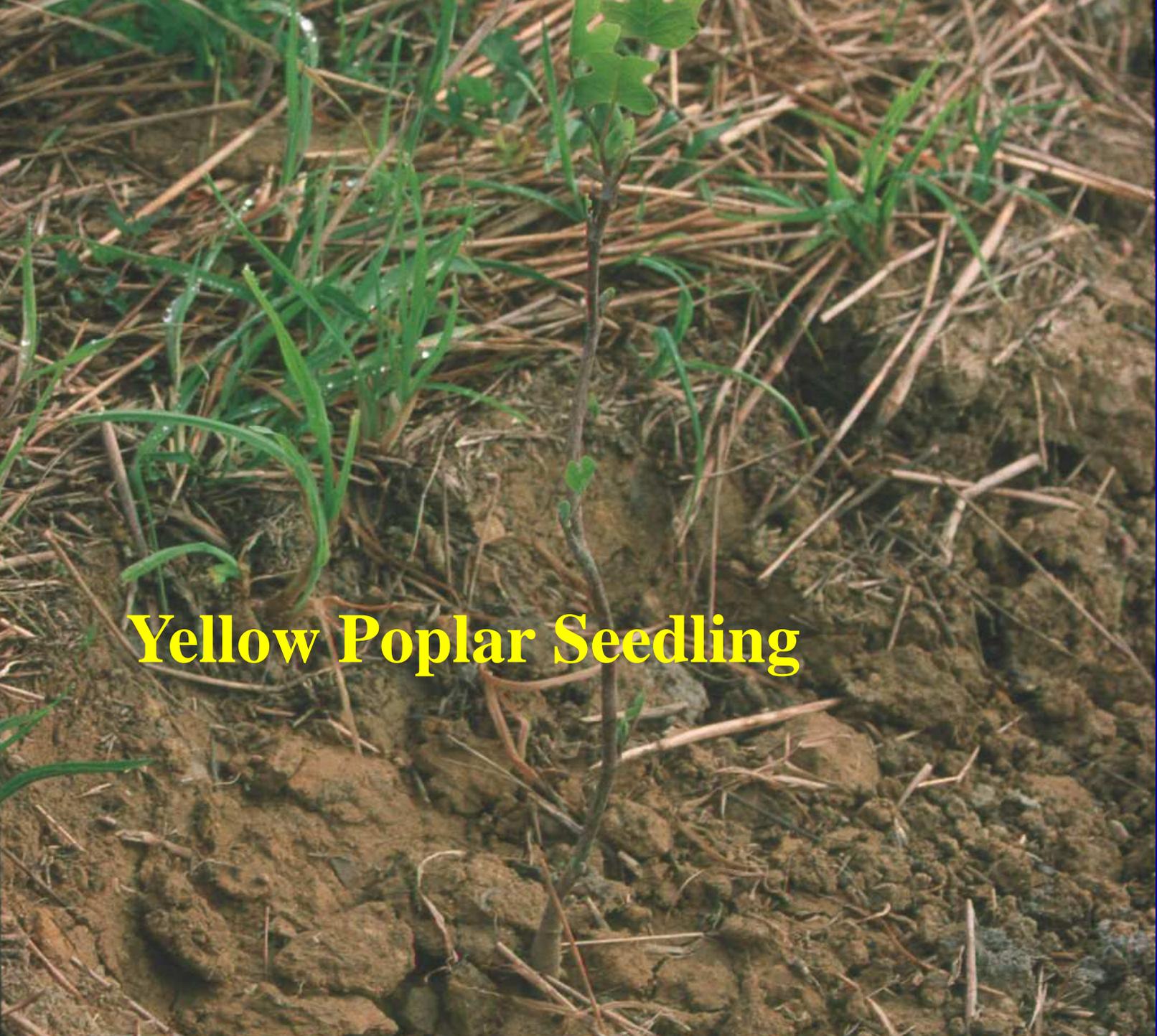


# North Aspect - Ripping



# Planting in Rips



A photograph of a young Yellow Poplar seedling. The seedling is a thin, dark brown stem with several small, bright green leaves at the top. It is growing out of a patch of dark brown, moist soil. The surrounding area is covered with a layer of dry, light brown straw or hay, interspersed with clumps of vibrant green grass. The entire image is framed by a solid blue border.

**Yellow Poplar Seedling**

**In addition to seedlings,  
Seeds of each species were planted**



# ANALYSIS

**Each treatment combination  
(aspect, mowing, and ripping)  
was replicated 4 times.**

**32 total plots x 30 trees  
(5 species x 6 reps)**

**Total: 960 trees, 960 seeds.  
184 per species**

**Statistics**

**MODEL TERMS**

**Aspect**

**Mowing**

**Ripping**

**Interactions**



**Monitoring: 1<sup>st</sup>, 2<sup>nd</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> Years**

**First Year - 2001**

**March 2005 – 5<sup>th</sup> year**



2005 3 21



**Seedlings**  
**August 2006 – 6<sup>th</sup> Year**

2006 8 1

**September 2007 – 7<sup>th</sup> Yr**



# SOIL CHARACTERISTICS

<u>1<sup>st</sup> Yr</u>	<u>pH</u>	<u>EC</u>	<u>Rocks</u>
		ds/m	%
North Topsoil	5.0	0.2	13
North Subsoil	8.3	2.3	52
South Topsoil	7.2	0.2	15
South Subsoil	8.7	2.5	48

# SOIL CHARACTERISTICS

<u>7<sup>th</sup> Yr</u>	<u>pH</u>	<u>EC</u>	<u>Rocks</u>
		ds/m	%
North Topsoil	5.6	0.1	10
North Subsoil	4.8	1.2	25
South Topsoil	7.2	0.1	11
South Subsoil	6.4	1.5	32

*North soils became more acid!*

# Black Cherry Seedlings from seed



# Black Cherry Seeds

## Treatments

1<sup>st</sup>

2<sup>nd</sup>

5<sup>th</sup>

7<sup>th</sup>

(coding?)

-----%-----

S-M-R

0

0

0

0

S-UM-R

0

0

4

4

S-M-UR

0

0

0

0

S-UM-UR

0

0

17

13

N-M-R

0

0

13

4

N-UM-R

0

0

0

0

N-M-UR

0

0

17

0

N-UM-UR

0

0

0

0

# Black Cherry Browsing

2006 8 1



# Red Oak Seedlings from seed



Great 1<sup>st</sup> year!

# Red Oak Seeds

## Treatments

1<sup>st</sup>

2<sup>nd</sup>

5<sup>th</sup>

7<sup>th</sup>

-----%-----

S-M-R

17

4

0

0

S-UM-R

33

8

0

0

S-M-UR

29

0

0

0

S-UM-UR

29

8

4

0

N-M-R

25

4

0

0

N-UM-R

33

29

13

13

N-M-UR

46

4

4

8

N-UM-UR

29

0

0

0

# Red Oak Seedling - Healthy

2006 8 1



# Red Oak Seedling – Not So Good...



2006 8 1

# Yellow Poplar Seedlings



# Yellow Poplar Seeds

Treatments

1<sup>st</sup>

2<sup>nd</sup>

5<sup>th</sup>

7<sup>th</sup>

-----%-----

S-M-R

S-UM-R

S-M-UR

S-UM-UR

Nothing!

N-M-R

N-UM-R

N-M-UR

N-UM-UR

# White Ash Seedlings



# White Ash Seeds

## Treatments

1<sup>st</sup>

2<sup>nd</sup>

5<sup>th</sup>

7<sup>th</sup>

-----%-----

S-M-R

0

0

0

0

S-UM-R

0

0

4

4

S-M-UR

0

0

0

0

S-UM-UR

0

0

0

0

N-M-R

0

0

0

0

N-UM-R

0

0

0

0

N-M-UR

0

0

8

4

N-UM-UR

0

0

4

4



# White Ash Seedling

2006 8 1



# White Ash Seedling Browsed

2006 8 1

# Black Walnut Seedlings



# Black Walnut Seeds

<u>Treatments</u>	<u>1<sup>st</sup></u>	<u>2<sup>nd</sup></u>	<u>5<sup>th</sup></u>	<u>7<sup>th</sup></u>
	-----%-----			
S-M-R	25	29	17	17
S-UM-R	38	42	46	46
S-M-UR	8	13	13	13
S-UM-UR	38	46	54	46
N-M-R	46	33	54	46
N-UM-R	63	67	54	54
N-M-UR	21	29	17	13
N-UM-UR	17	33	33	33

# Black Walnut Seedling

2006 8 1



# Black Walnut Seedling – S aspect



2006 8 1

# Average Survival Seeds – 7<sup>th</sup> Yr

<u>Treatments</u>	<u>BC</u>	<u>RO</u>	<u>YP</u>	<u>BW</u>	<u>WA</u>
	-----%-----				
<b>North</b>	<b>1</b>	<b>5</b>	<b>0</b>	<b>36</b>	<b>2</b>
<b>South</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>30</b>	<b>1</b>
<b>Unmowed</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>45</b>	<b>1</b>
<b>Mowed</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>22</b>	<b>2</b>
<b>Unripped</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>26</b>	<b>1</b>
<b>Ripped</b>	<b>2</b>	<b>3</b>	<b>0</b>	<b>41</b>	<b>2</b>
<b>Average</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>34</b>	<b>2</b>

# Growth of Seeds – 7<sup>th</sup> Yr

<u>Treatments</u>	<u>BC</u>	<u>RO</u>	<u>YP</u>	<u>BW</u>	<u>WA</u>
	----- cm <sup>3</sup> -----				
<b>S-M-R</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>58</b>	<b>0</b>
<b>S-UM-R</b>	<b>21</b>	<b>0</b>	<b>0</b>	<b>77</b>	<b>20</b>
<b>S-M-UR</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>0</b>
<b>S-UM-UR</b>	<b>20</b>	<b>0</b>	<b>0</b>	<b>51</b>	<b>0</b>
<b>N-M-R</b>	<b>43</b>	<b>0</b>	<b>0</b>	<b>68</b>	<b>0</b>
<b>N-UM-R</b>	<b>0</b>	<b>26</b>	<b>0</b>	<b>79</b>	<b>0</b>
<b>N-M-UR</b>	<b>0</b>	<b>39</b>	<b>0</b>	<b>61</b>	<b>88</b>
<b>N-UM-UR</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>89</b>	<b>21</b>

# % Change in Growth – 5<sup>th</sup> to 7<sup>th</sup> Yr

<u>Treatments</u>	<u>BC</u>	<u>RO</u>	<u>YP</u>	<u>BW</u>	<u>WA</u>
	-----cm <sup>3</sup> -----				
S-M-R	0	0	0	+230	0
S-UM-R	+231	0	0	+240	+257
S-M-UR	0	0	0	-15	0
S-UM-UR	+107	0	0	+92	0
N-M-R	+1948	0	0	+65	0
N-UM-R	0	+467	0	+207	0
N-M-UR	0	+2267	0	+335	-61
N-UM-UR	0	0	0	+300	+89

# CONCLUSION

**Seeds after 7 yrs**

**Black Cherry – 15 to 3%**

**Red Oak – 30 to 3%**

**Black Walnut - 34%**

**White Ash - 2%**

**Yellow Poplar – 0%**

# CONCLUSION

**Survival was generally better:**

- **North-facing aspects** (moisture)
  - **Ripped plots** (rooting volume)
- **Unmowed plots** (denser cover, hidden)

**Regulators say:**

**Trees won't grow on mined sites!**



**We need more ground cover!**

2005 7 13

# Large Expanses of Pastures





# Tree and Shrub Wastelands



**Trees will grow on mined lands!**





**Let's encourage tree planting!**



**ARRI Signatories**