FRA Step 3: Use Compatible Ground Covers

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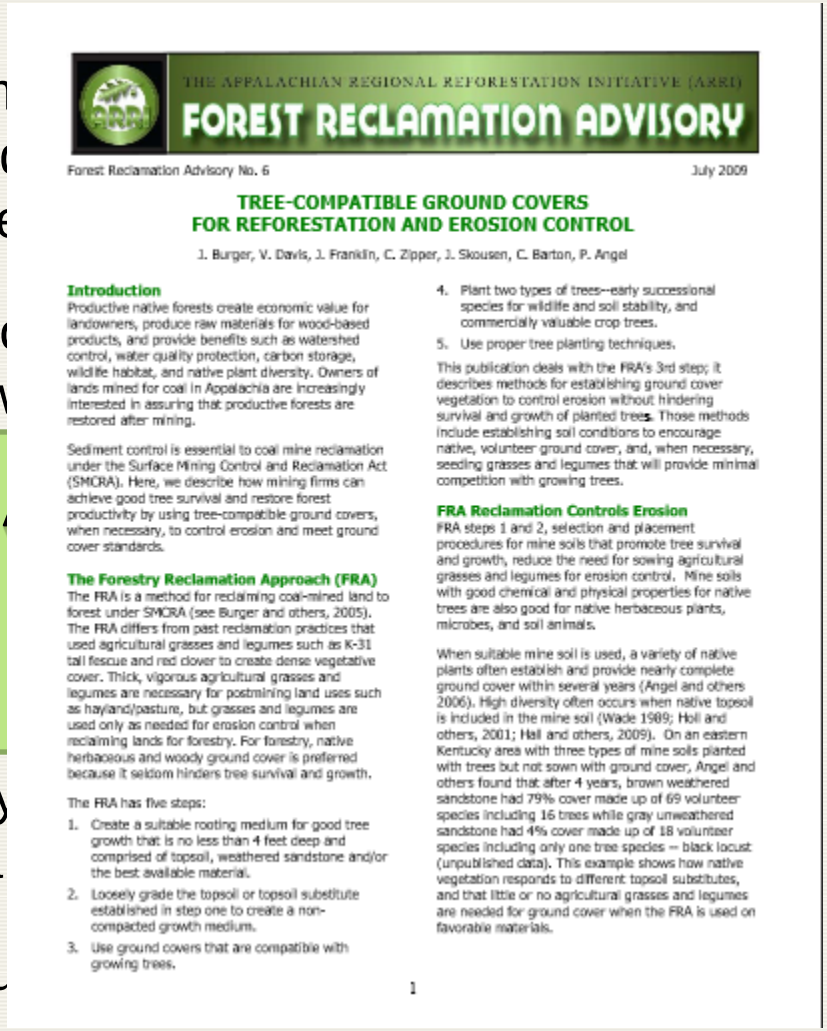
FORESTRY RECLAMATION APPROACH

- 1. Create a suitable rooting medium less than 4 feet deep and comprised sandstone, and/or the best available
- 2. Loosely grade the topsoil or topso one to create a non-compacted grow
- **3. USE GROUND COVERS THAT A GROWING TREES**

  FOREST RECLAMATION ADVISORY #6
- 4. Plant two types of trees – 1) early and soil stability, and 2) commercia
- 5. Use proper tree planting techniqu



THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI)

FOREST RECLAMATION ADVISORY

Forest Reclamation Advisory No. 6 — July 2009

TREE-COMPATIBLE GROUND COVERS FOR REFORESTATION AND EROSION CONTROL

J. Burger, V. Davis, J. Franklin, C. Zipper, J. Skousen, C. Barton, P. Angel

Introduction

Productive native forests create economic value for landowners, produce raw materials for wood-based products, and provide benefits such as watershed control, water quality protection, carbon storage, wildlife habitat, and native plant diversity. Owners of lands mined for coal in Appalachia are increasingly interested in assuring that productive forests are restored after mining.

Sediment control is essential to coal mine reclamation under the Surface Mining Control and Reclamation Act (SMCRA). Here, we describe how mining firms can achieve good tree survival and restore forest productivity by using tree-compatible ground covers, when necessary, to control erosion and meet ground cover standards.

The Forestry Reclamation Approach (FRA)

The FRA is a method for reclaiming coal-mined land to forest under SMCRA (see Burger and others, 2005). The FRA differs from past reclamation practices that used agricultural grasses and legumes such as K-31 tall fescue and red clover to create dense vegetative cover. Thick, vigorous agricultural grasses and legumes are necessary for postmining land uses such as hayland/pasture, but grasses and legumes are used only as needed for erosion control when reclaiming lands for forestry. For forestry, native herbaceous and woody ground cover is preferred because it seldom hinders tree survival and growth.

The FRA has five steps:

1. 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.
2. Loosely grade the topsoil or topsoil substitute established in step one to create a non-compacted growth medium.
3. Use ground covers that are compatible with growing trees.
4. Plant two types of trees--early successional species for wildlife and soil stability, and commercially valuable crop trees.
5. Use proper tree planting techniques.

This publication deals with the FRA's 3rd step; it describes methods for establishing ground cover vegetation to control erosion without hindering survival and growth of planted trees. Those methods include establishing soil conditions to encourage native, volunteer ground cover, and, when necessary, seeding grasses and legumes that will provide minimal competition with growing trees.

FRA Reclamation Controls Erosion

FRA steps 1 and 2, selection and placement procedures for mine soils that promote tree survival and growth, reduce the need for sowing agricultural grasses and legumes for erosion control. Mine soils with good chemical and physical properties for native trees are also good for native herbaceous plants, microbes, and soil animals.

When suitable mine soil is used, a variety of native plants often establish and provide nearly complete ground cover within several years (Angel and others 2006). High diversity often occurs when native topsoil is included in the mine soil (Wade 1989; Holl and others, 2001; Hall and others, 2009). On an eastern Kentucky area with three types of mine soils planted with trees but not sown with ground cover, Angel and others found that after 4 years, brown weathered sandstone had 79% cover made up of 69 volunteer species including 16 trees while gray unweathered sandstone had 4% cover made up of 18 volunteer species including only one tree species – black locust (unpublished data). This example shows how native vegetation responds to different topsoil substitutes, and that little or no agricultural grasses and legumes are needed for ground cover when the FRA is used on favorable materials.

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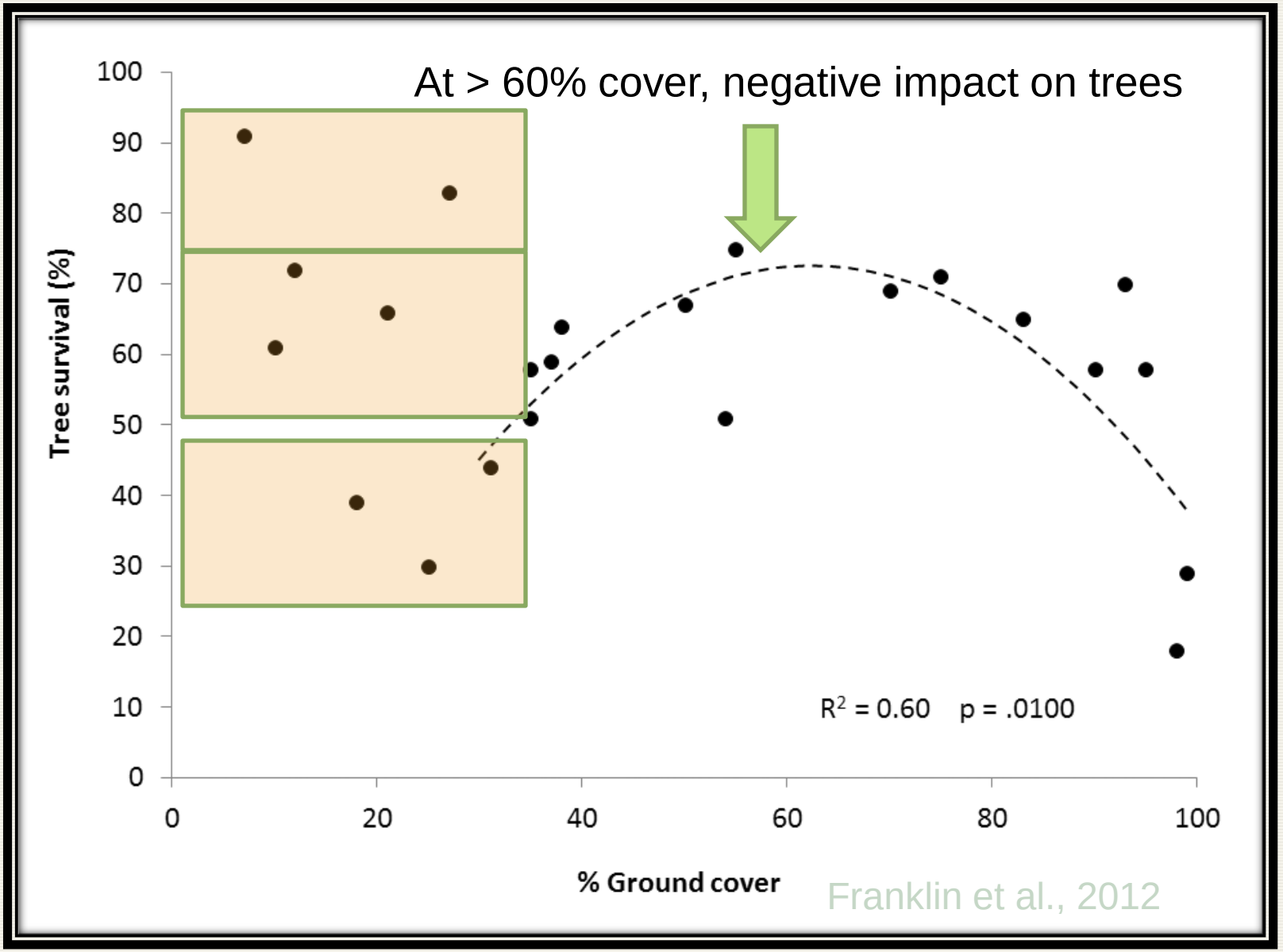
Adjacent plants compete for:

1. Light
2. Water
3. Mineral nutrients

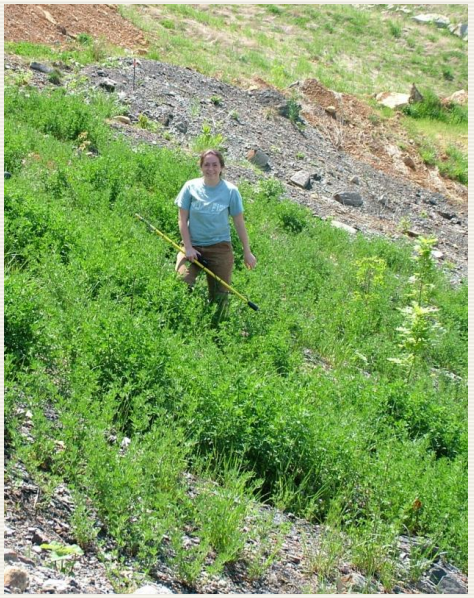
Herbicidal control: consistently increases tree growth and survival

Herbaceous density



Tree-compatible ground covers:

- Are low-growing so sunlight reaches the tree seedlings.
- Withdraw water and nutrients from the soil slowly.
- Do not cover the ground rapidly or completely to allow native seed to colonize.
- Allows rapid establishment and growth of native trees which minimizes the invasion of exotics.



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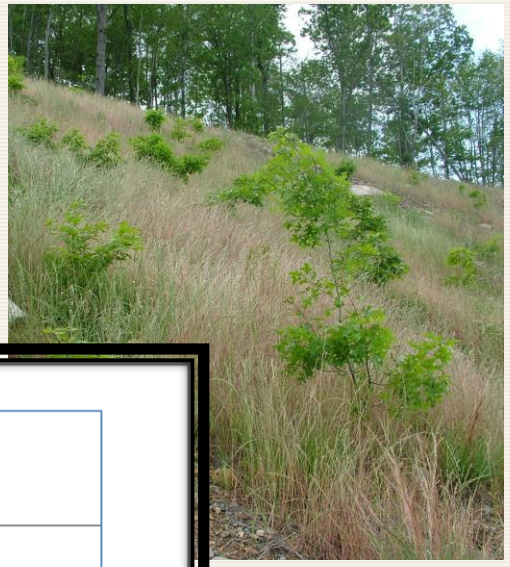
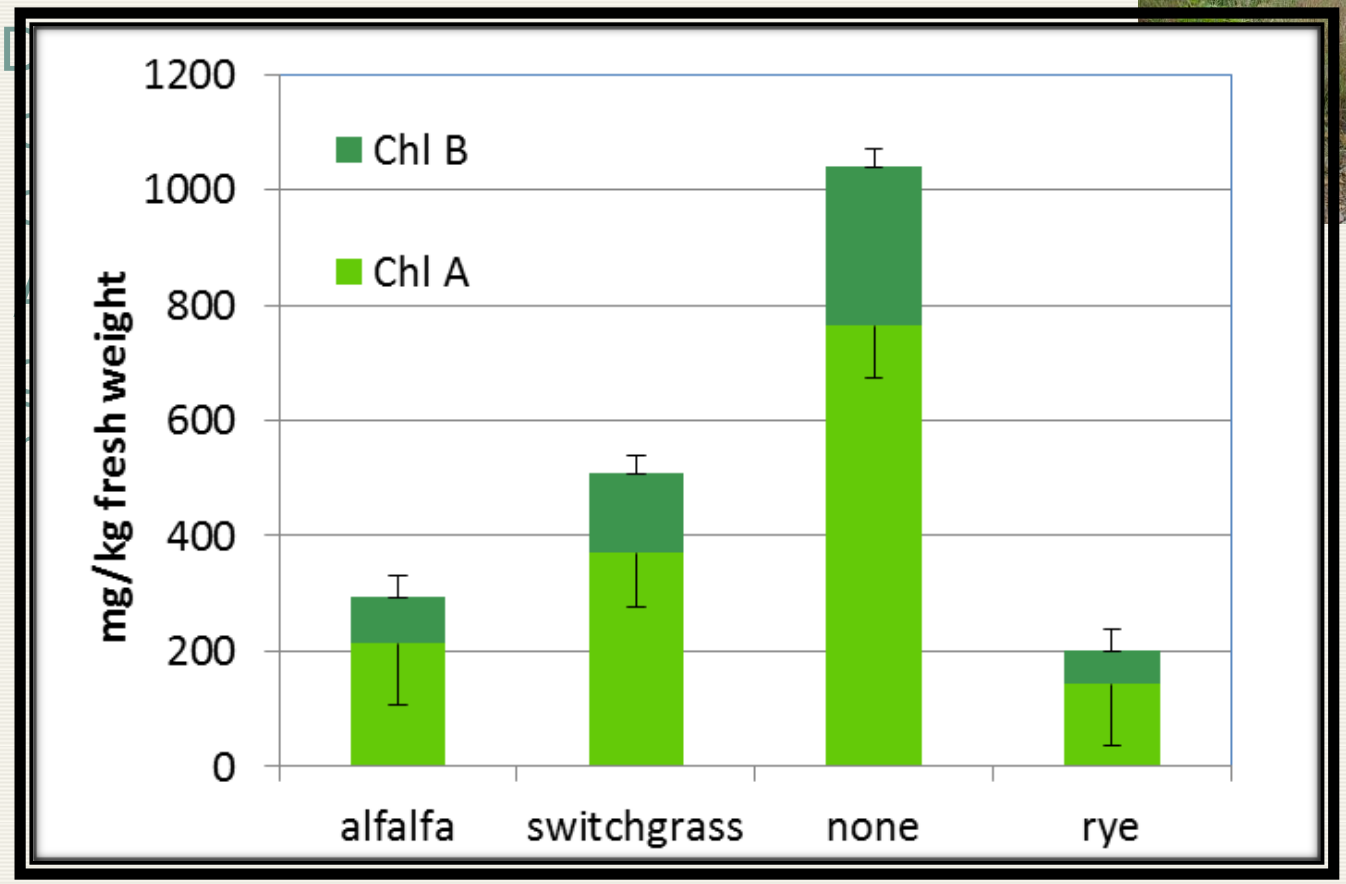
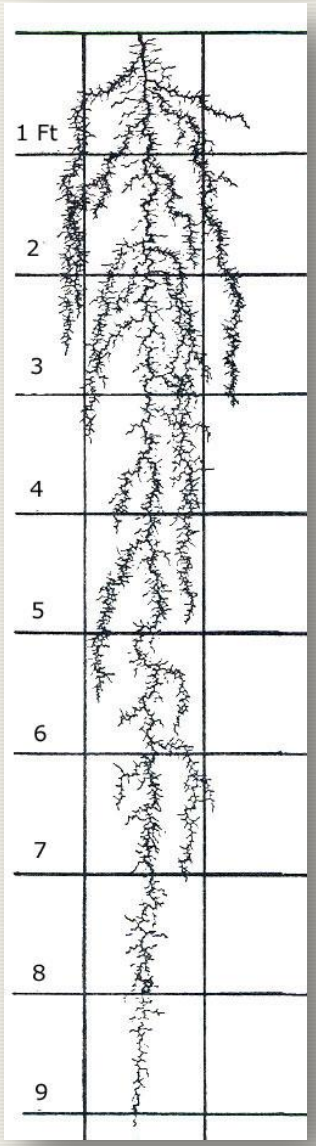
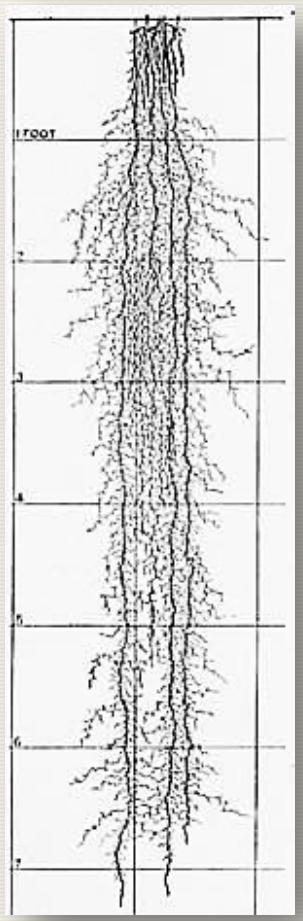
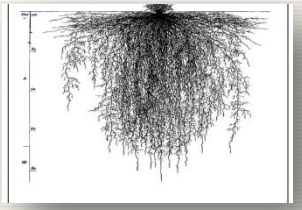








Weaver, 1926



Pierret, 2007

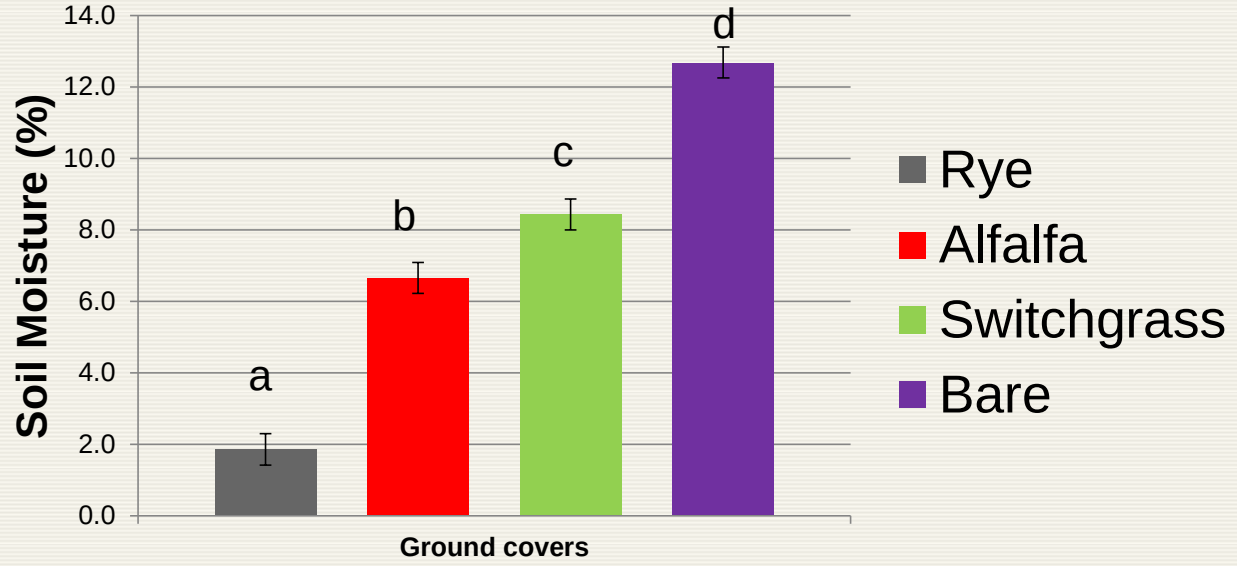
Native

Alfalfa (***Medicago sativa***)

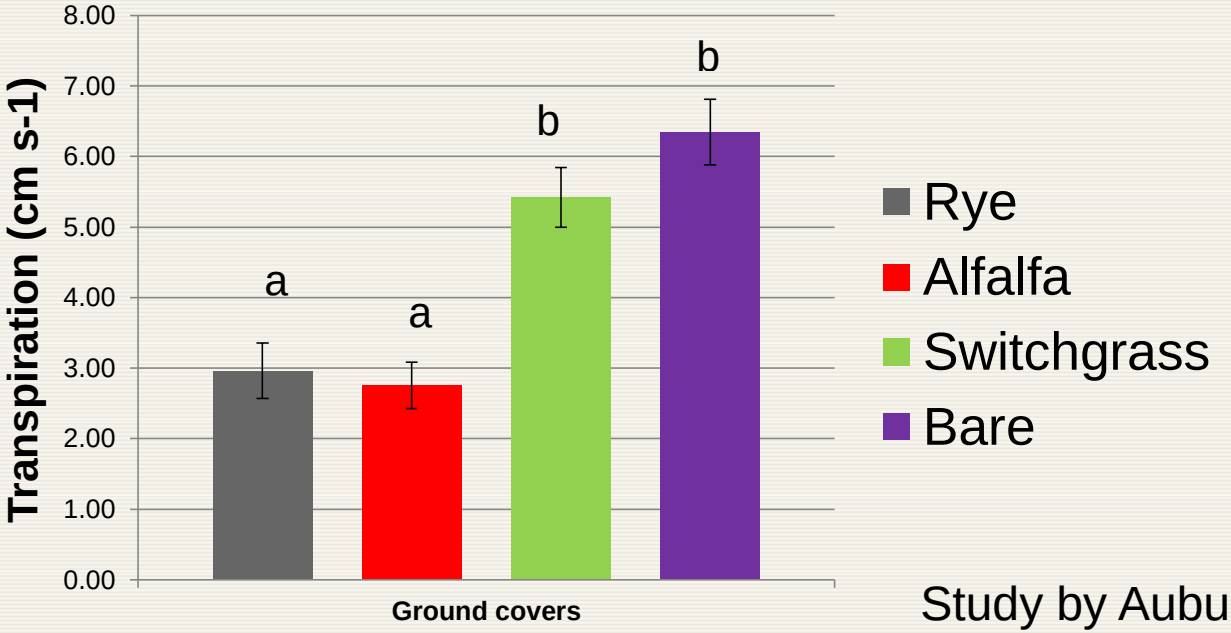
Switchgrass (***Panicum virgatum***)

Ryegrass (***Lolium multiflorum***)

Soil Moisture on 5/19/2010



Oak transpiration on 5/19/2010



Study by Aubuchon

Roots of oak seedlings grown for 3 months with different ground covers

alfalfa
Medicago sativa

bare ground

rye grass
Lolium multiflorum

switchgrass
Panicum virgatum


legume
Cercis canadensis
turf grass
native grass
native grass

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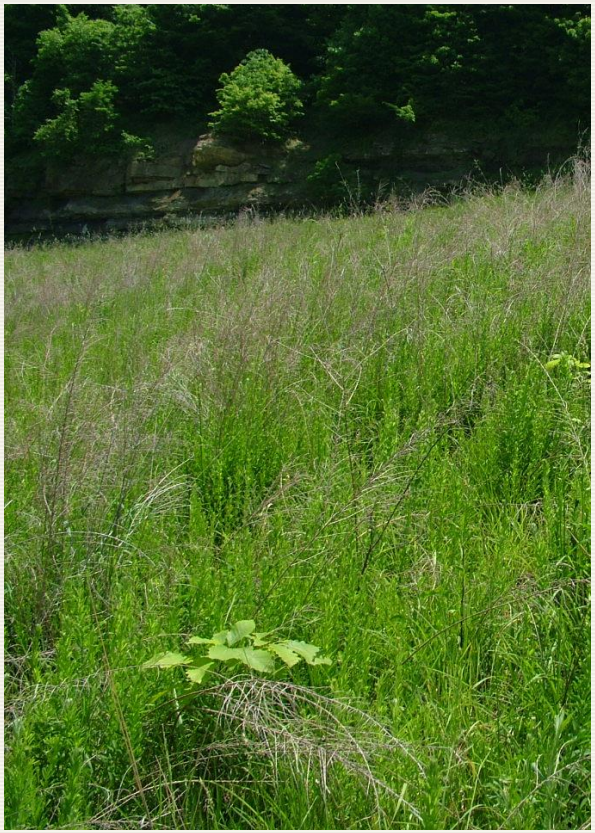
- **Have low persistence in your area.**



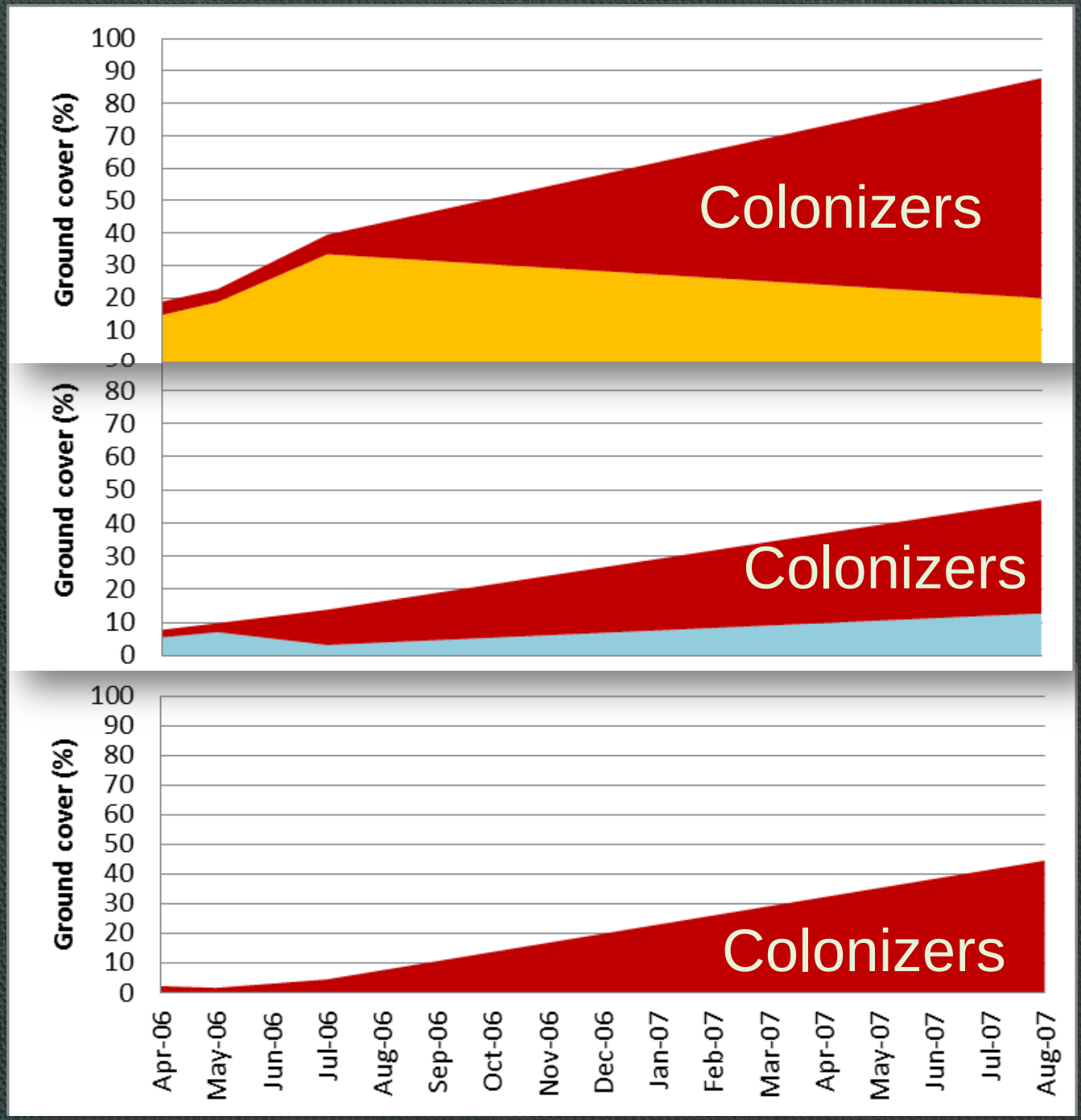
NOT THIS!

Low persistence

Alfalfa (orange)

Switchgrass (blue)

No planted ground cover



Maximizing seeding success: Stratify your site

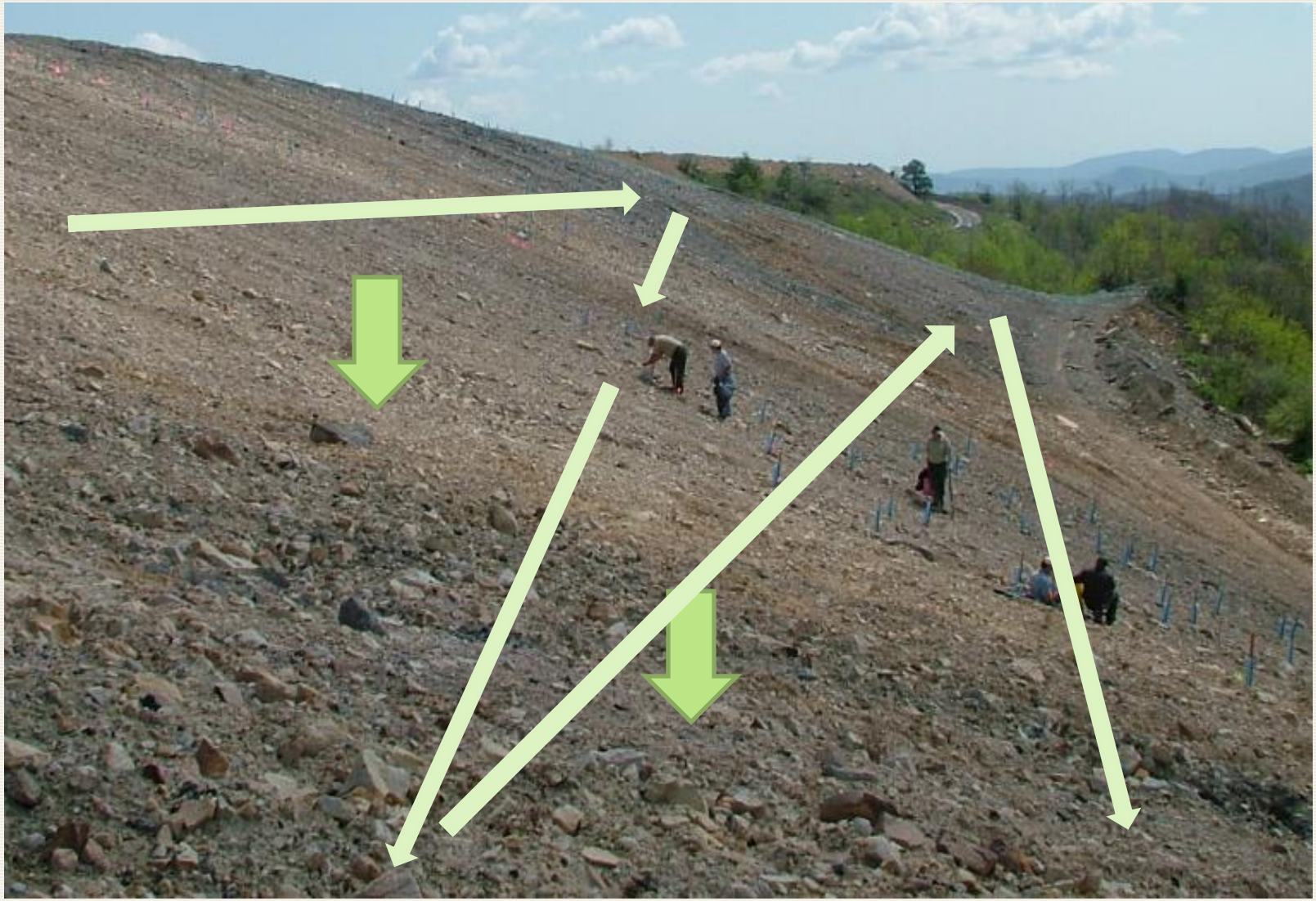
Depending on how variable your materials and topography are, it may be helpful to delineate 2 or more zones across your landscape.

These are often based on material type, or moisture.

Soil testing

- Native plants grow best when soil chemistry is similar to native soils.
- Amendments often needed to adjust pH, and add nutrients.
- Site-specific amendments and ground covers needed to ensure success.
- Specify “Wildlife”, “Conservation”, or “Forestry” when sending soil to the lab.

Materials vary in chemistry- soil sample should include range of materials



Amendments

Soils for reforestation should be slightly acidic and have fewer nutrients than soils for grasslands

Lime only when pH is below 5.5

Organic matter improves soil conditions on many sites

Even small amounts of topsoil can add beneficial soil organisms, but can also introduce unwanted species

Fertilizer application

- Nitrogen (N) 50-75 lb/ac
- Phosphorus (as P) 80-100 lb/ac
- (as P2O5) 180-230 lb/ac

Density of herbaceous vegetation is closely related to soil fertility in our area, follow recommended rates.

Plant selection and seeding

Shade or sun?
Late successional species may not establish well. Choose sun-loving species.

Water availability

Climate

Depth to water table

Soil type:

- coarse soils low water
- Organic matter moister

North slopes moister

Topography

Classification by water requirements:

Upland, Mesic, Facultative wetland, Wetland

Soil pH

Many agronomics prefer pH 6.0-7.0

Find herbaceous species tolerant of your site, rather than adding lime to raise pH.

Other considerations:

- Native status
- Rate of spread or persistence
- Wildlife benefit
- Aesthetics
- Life form or size
- Ease of establishment
- Availability
- Cost
- Future management

Components of a seeding mix

- Annual – rapid cover to hold nutrients and improve site conditions
- Legumes – increase soil nitrogen
- Perennials – longer lasting cover

How many species to seed?

More species =

less chance of cover dense enough to choke out

Growth over a variety of materials and moisture

Diversity in all seasons

Diversity and density

- Optimal number of species is about 10
- Depends on potential for native dispersal onto the site – leave gaps
- Potential for invasive dispersal onto site – no gaps

Sites seeded with native warm season grasses are slow to establish, but result in a diverse mixture of grasses and forbs.

2006

2008

Conclusion: minimize competition through control of density and species composition

Franklin, J. A., C. E. Zipper, J. A. Burger, J. G. Skousen, and D. F. Jacobs. 2012. Influence of herbaceous ground cover on forest restoration of eastern US coal surface mines. New Forests 43:905-924.

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50 year old native hardwood forest on former coal mine in Tennessee


Questions?
Now, select the proper tree species...