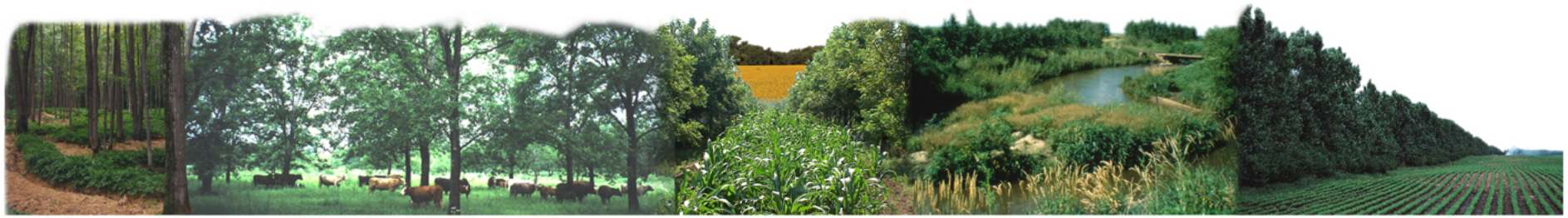
An Overview of Agroforestry Practices

Gene Garrett, MU Center for Agroforestry

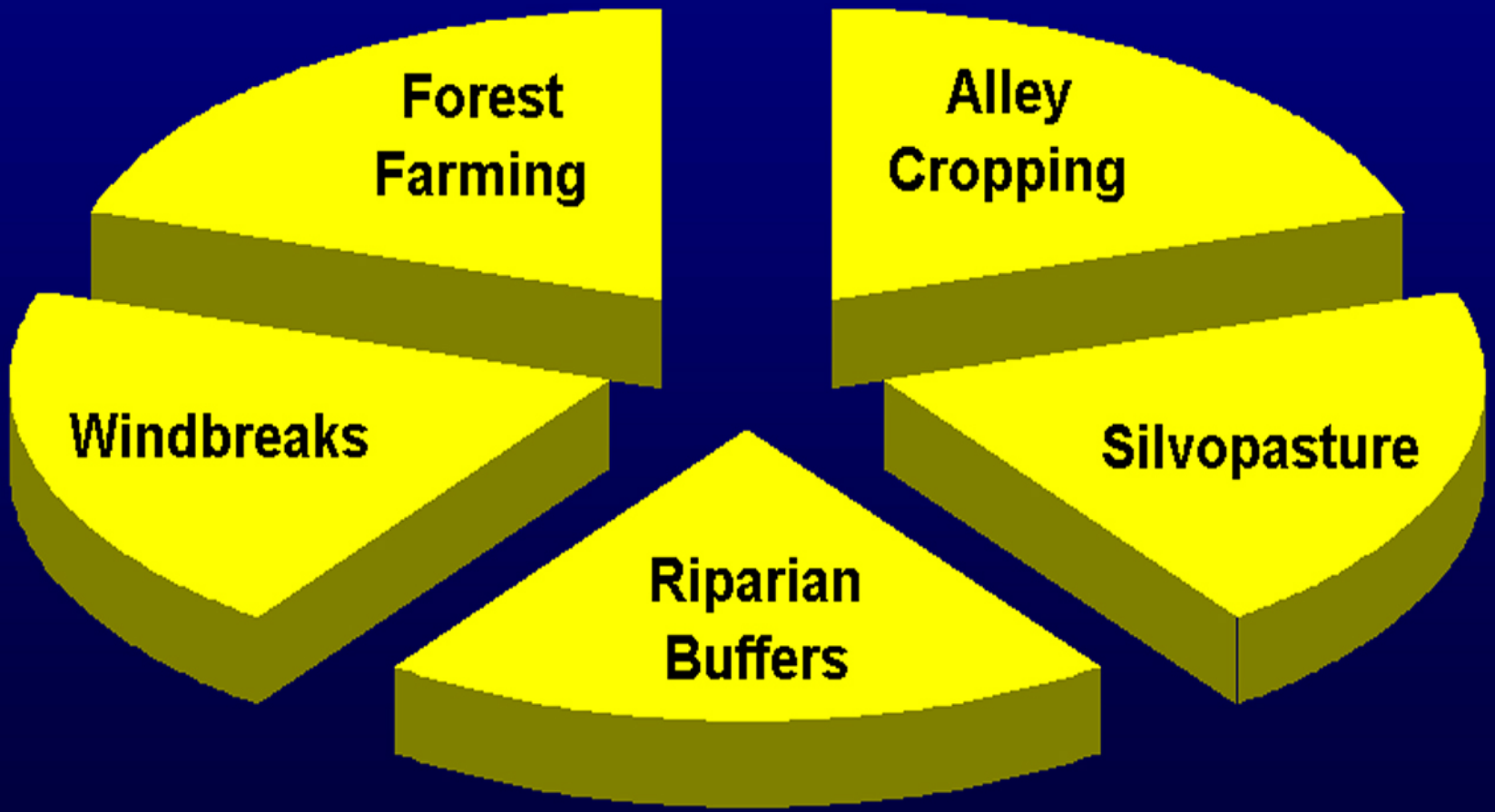


What is agroforestry?

Agroforestry combines trees and livestock, crops or forest-grown products to achieve economic, conservation, and ecological goals.

Agroforestry Practices

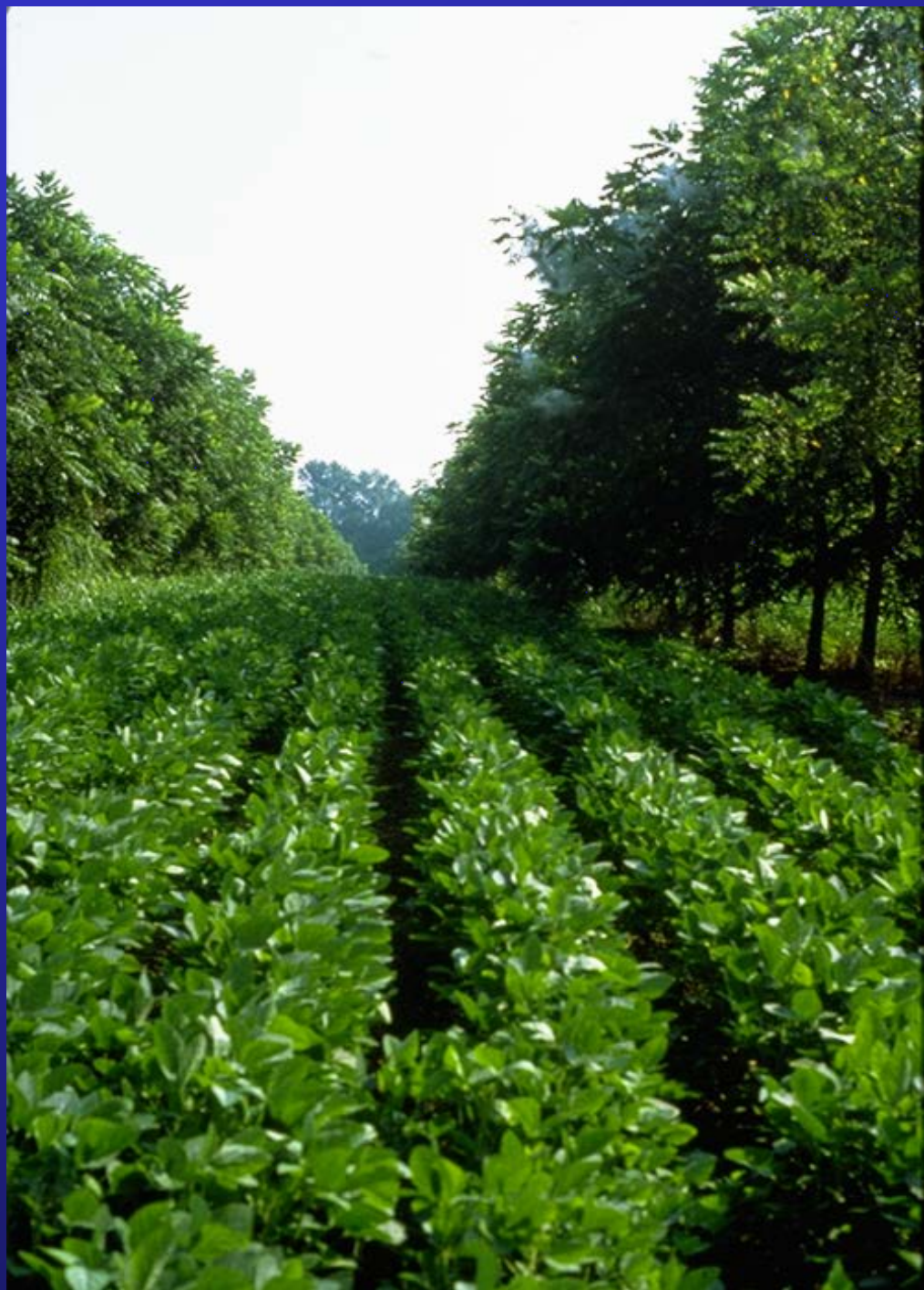
Five Temperate Practices



Alley Cropping

Alley cropping is the growing of an annual or perennial crop between rows of high-value trees.

The agricultural crop generates an annual income while the longer-term tree crop matures.



Spacing Considerations

6 row corn planter, trees on 22.5 foot centers, 5 feet between trees in the row

Age 3

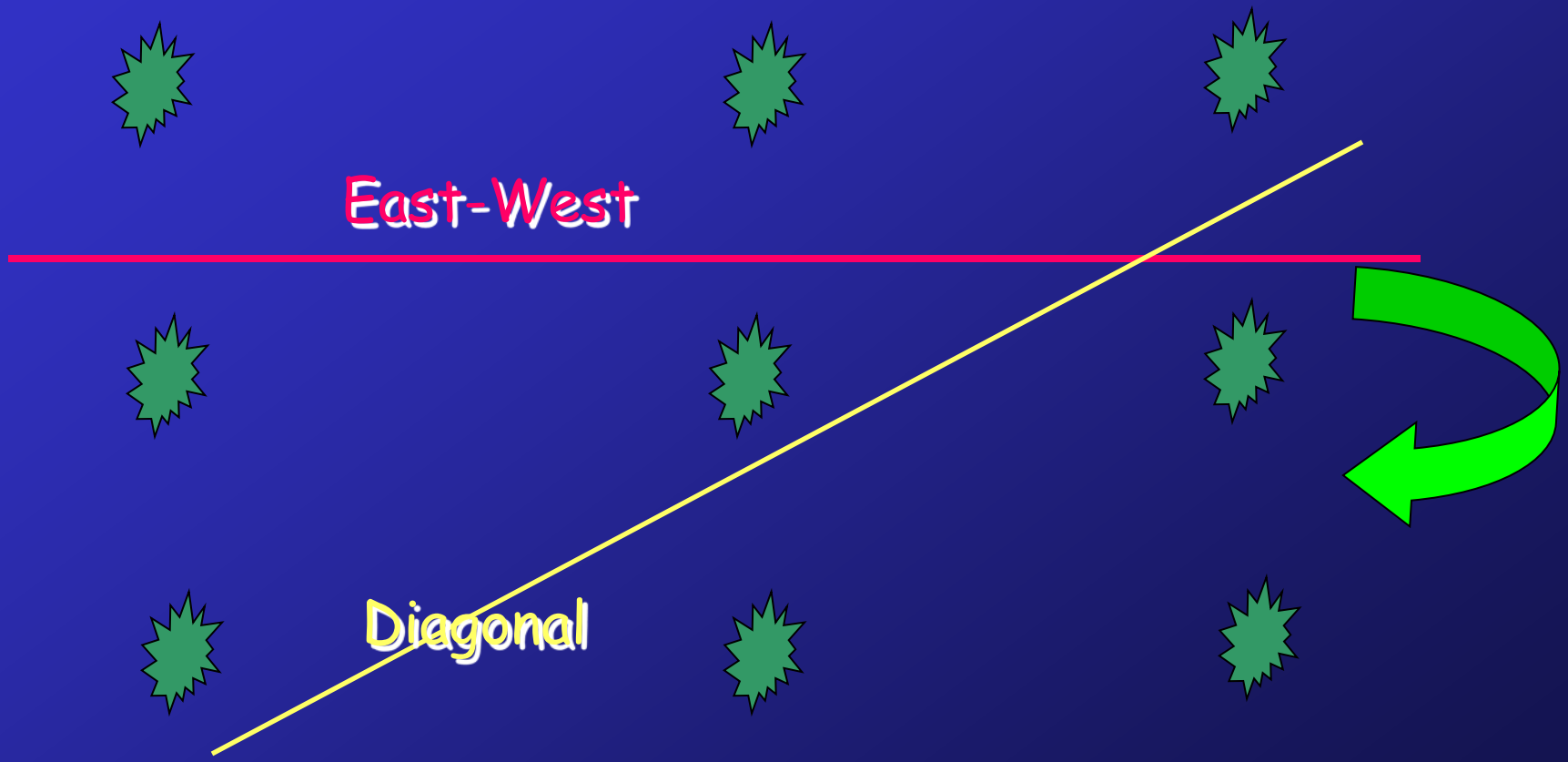
Age 9, 35 ft. tall and time to thin


Row Orientation

AREA OF EMPHASIS?

- An east/west orientation maximizes the light reaching the alleyway—increasing alleyway yields
- A north/south orientation maximizes the light the trees are exposed to—increasing nut and fruit production?

Equipment Travel Lanes



Plant Materials - Trees

Species Selection

1. Trees matched to site conditions
2. Produce a light shade
3. Produce desired products
   -- Nuts, Timber, Honey …
4. High value
   -- grafted vs. nursery seedlings
   -- Black Walnut vs. White Oak
5. Deep rooted or minimal surface roots
6. Provides additional wildlife habitat to the site

Agroforestry Specialty Crops for the Small Farm

- examples from the Midwest -

Chestnut

- Under a well managed orchard, yields should reach 2,000 lbs per acre by age 10 (from graft).
- Gross wholesale profit ranges from $3,000-$7,000, or more, per acre.
- Markets need to be developed.

Agroforestry Specialty Crops for the Small Farm

- examples from the Midwest -

Pine straw

- Under management, pine should yield from 100 to 250 bales (35 lbs) every other year.
- Sales may bring from $3 - $5.50/bale, wholesale.

Plant Materials
Companion Crops

Potential Companions:

- Row / cereal crops
- Forage crops
- Specialty crops


MF

Black Walnut in 40x10-foot spacing at age 10.

Over time increased shade will dictate conversion to more shade tolerant crops (i.e. row crops to forages).

Orchard grass/red clover in black walnut

Silvopasture

The Intentional combining of trees and/or shrubs, forage and livestock.

Allowing livestock to graze in a natural woodland area without any type of tree or forage management is *not* considered agroforestry.

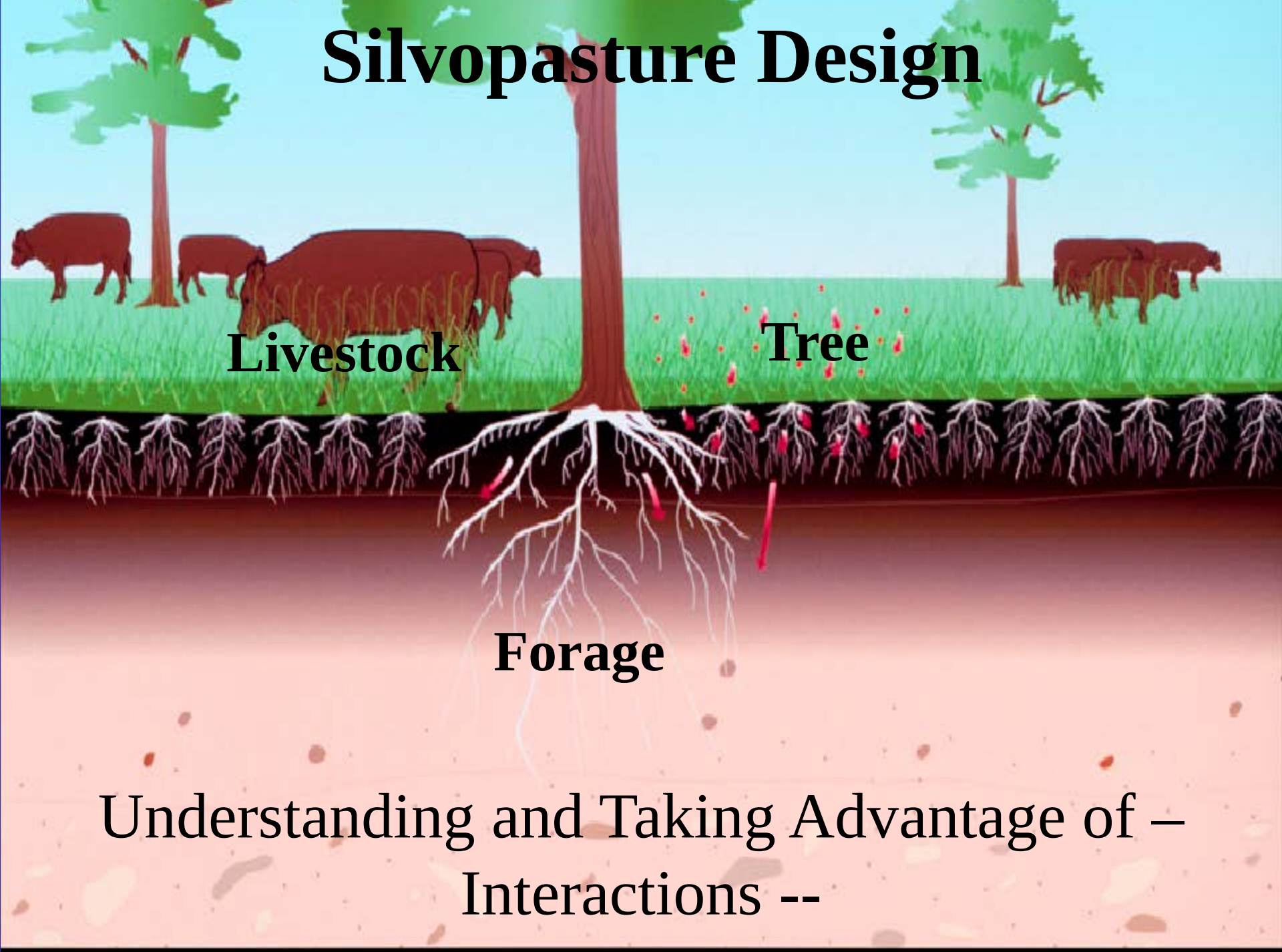
Is this Silvopasture???

Shade – good and bad

- If you don’t have uniform shade, cattle tend to congregate under the shade even when they don’t need it
  - Time spent under shade reduces time spent grazing
  - Less grazing time results in less intake and reduced performance

- WHAT DO WE KNOW?

Silvopasture Design



Understanding and Taking Advantage of – Interactions --

INTEGRATING TREES, FORAGES, AND ANIMALS

- The four variables in a silvopastoral practice that can be subjected to management are:

- Tree Species.
- Tree Density.
- Forage Species.
- Animal Maintenance.

TREE SPECIES

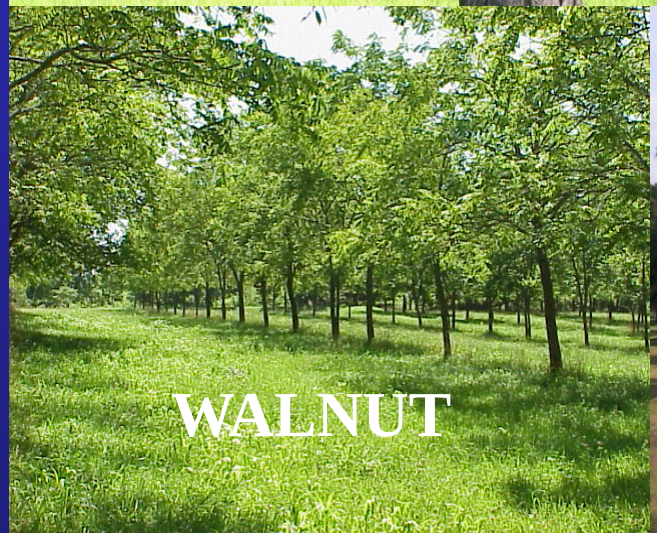
- Since there is a strong correlation between forage production and light intensity, when possible select a tree species that creates “light” shade (walnut is an example).

Desirable Tree Species

- Loblolly Pine
- Slash Pine
- Longleaf Pine
- Shortleaf Pine
- Black Walnut
- Pecan
- Bur Oak
- Red Oaks
- White Oaks

(Low site oaks)

- Post Oak?
- Hickories?



TREE DENSITY

- Under conditions where it is not desirable or even possible (e.g., a native stand of oak) to manage a species that produces light shade, we must realize the importance of thinning and pruning for light management purposes—light availability is a function of tree spacing, tree crown diameter, and tree crown density.
- Our research has shown that light levels 40% to 60% of that in the open are desirable in order to create quality silvopasture.

The Effect of Light / Shade

(40 - 60% *shade* is *ideal*)

1. Yields can be maintained --
   Select the appropriate forage combination(s).

2. Improved quality

   a) Reduced lignin &
      improved digestibility

   b) Increased or no change in crude protein

   c) Improved N content

FORAGE SPECIES

- Forage must show the appropriate degree of shade tolerance and be able to compete with the tree species for moisture.

ANIMAL MAINTENANCE

- Maintain the proper stocking density (i.e., do not exceed carrying capacity of site).
- Use rotational grazing instead of continuous grazing.
- Remove livestock during excessively wet periods to minimize tree root damage and soil compaction.

Key Elements of Management in Design of a Successful Silvopasture Practice

1) Appropriate *Light* Levels (manage the trees);
2) Appropriate *Forage* Selections;
3) Appropriate *Site* Selection.
4) Management Intensive Grazing!

--An Understanding that Change is inevitable!

--Management must be designed to enhance the availability of limited resources.

TWO APPROACHES

Establish trees in pastures

Establish pastures in trees

Electric fence protects young trees, 40x10’ spacing, 108 trees/acre, trees planted into tall fescue pasture

Loblolly pine

Silvopasture – thinning natural stands and establishing domestic forages

Silvopasture

Cattle rotationally-grazed in a native pecan stand

DESIRED OUTCOMES

- Improved productivity of grazing animals.
- Improved quality and diversity of forage available to grazing animals and wildlife.
- Effectively interposed timber stand improvement in unmanaged stands.
- Increased establishment and growth of high quality trees in pastures.
- Increased wildlife benefits.

Windbreak / Shelterbelt / Timberbelt

Definition

Plantings of single or multiple rows of trees or shrubs that are established for one or more purposes.

Planted and managed as part of a crop or livestock operation to enhance crop production, protect livestock, manage snow distribution, control soil erosion and create wildlife habitat.

How do Windbreaks provide these Benefits?

Windbreak function depends upon six key windbreak components:

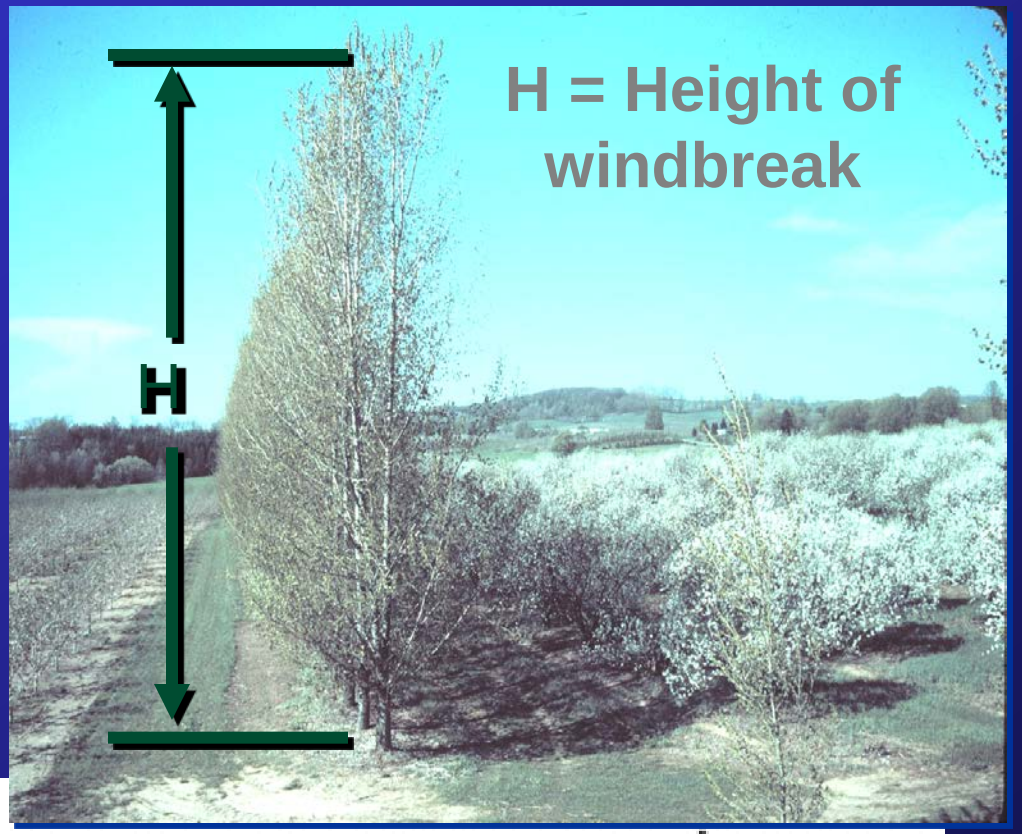
- Height
- Density
- Orientation
- Length
- Width
- Continuity

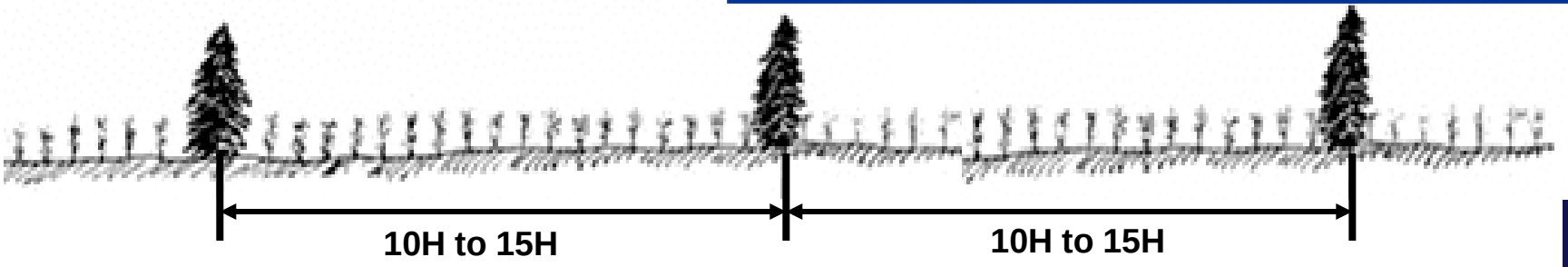
Why Is Windbreak Height Important?

Element: Height

Match height to achieve desired protected area

The height determines the distance of the sheltered zone. For example, select the tallest trees suited to the site for large fields and fewest windbreaks.





Windbreak Density

Dense =
Maximum wind reduction but short wind shadow

Moderately Dense =
Less wind reduction but longer wind shadow

Open Wind Speed 20 mph
Deciduous 25-35% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	10	13	16	17	20
% of open wind speed	50%	65%	80%	85%	100%

Open Wind Speed 20 mph
Conifer 40-60% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	6	10	12	15	19
% of open wind speed	30%	50%	60%	75%	95%

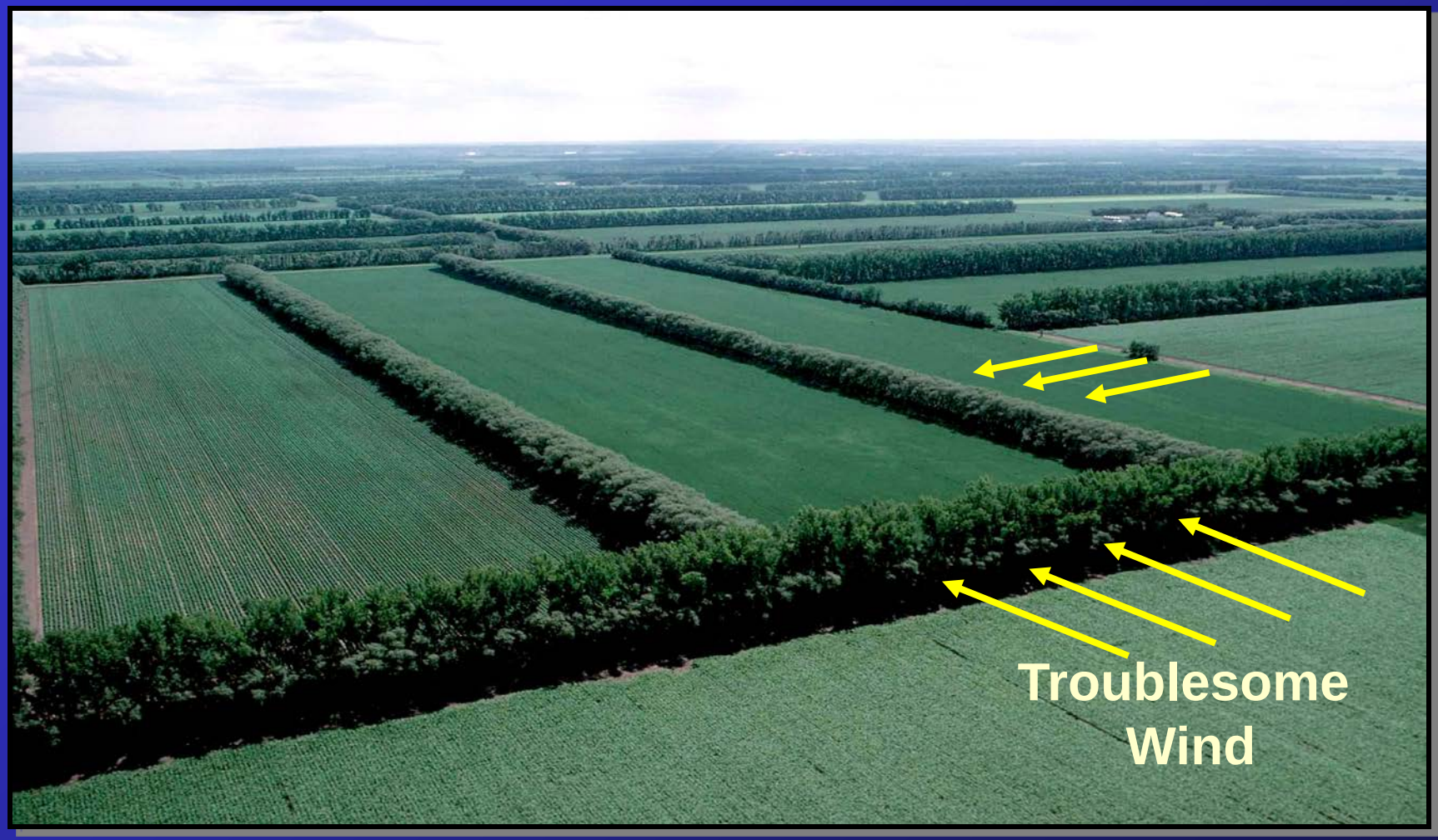
Open Wind Speed 20 mph
Multi Row 60-80% density

H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	5	7	13	17	19
% of open wind speed	25%	35%	65%	85%	95%

Open Wind Speed 20 mph
Solid Fence 100% density

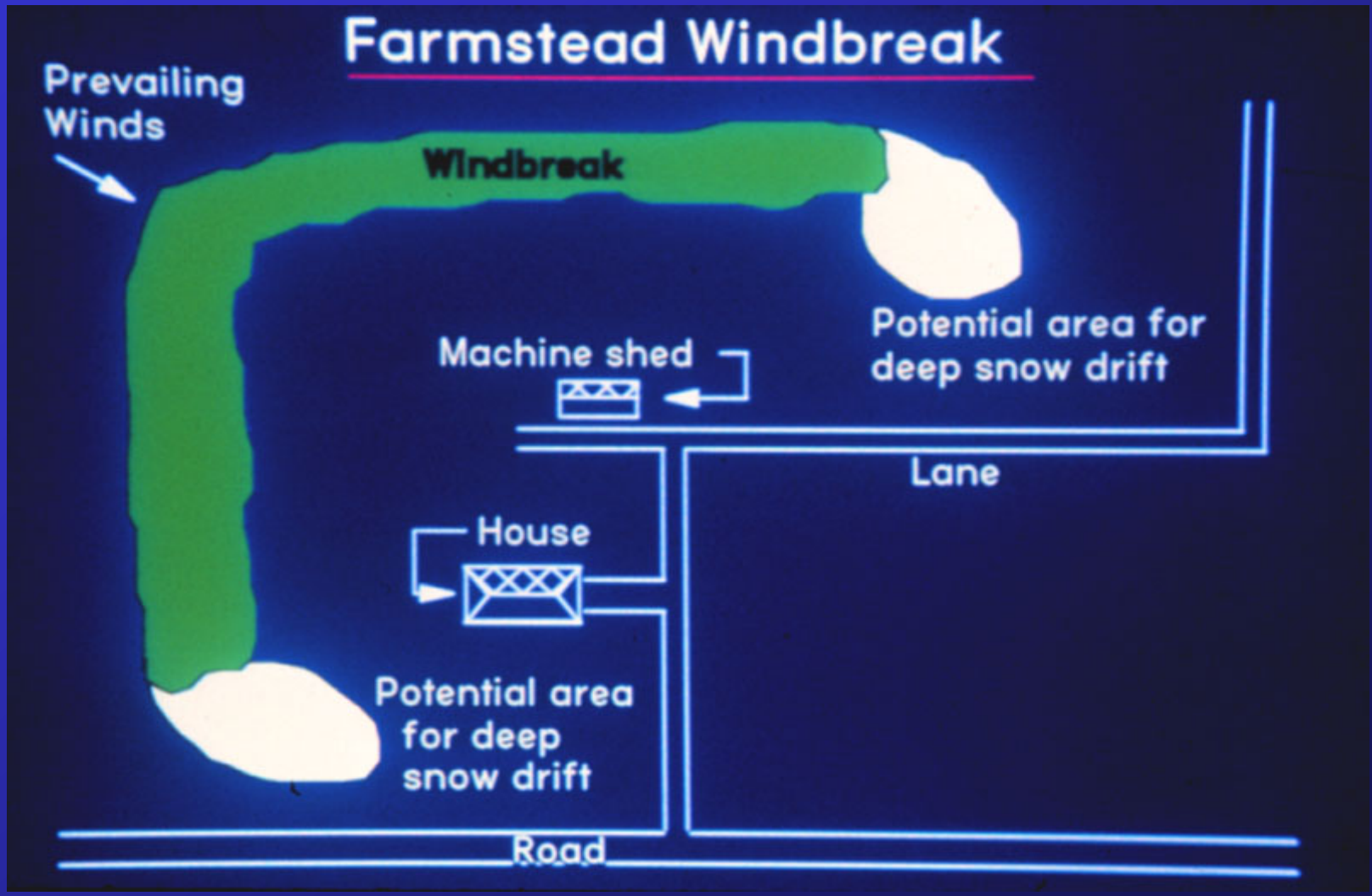
H distance from windbreak	5H	10H	15H	20H	30H
Miles per hour	5	14	18	19	20
% of open wind speed	25%	70%	90%	95%	100%

Windbreak Orientation

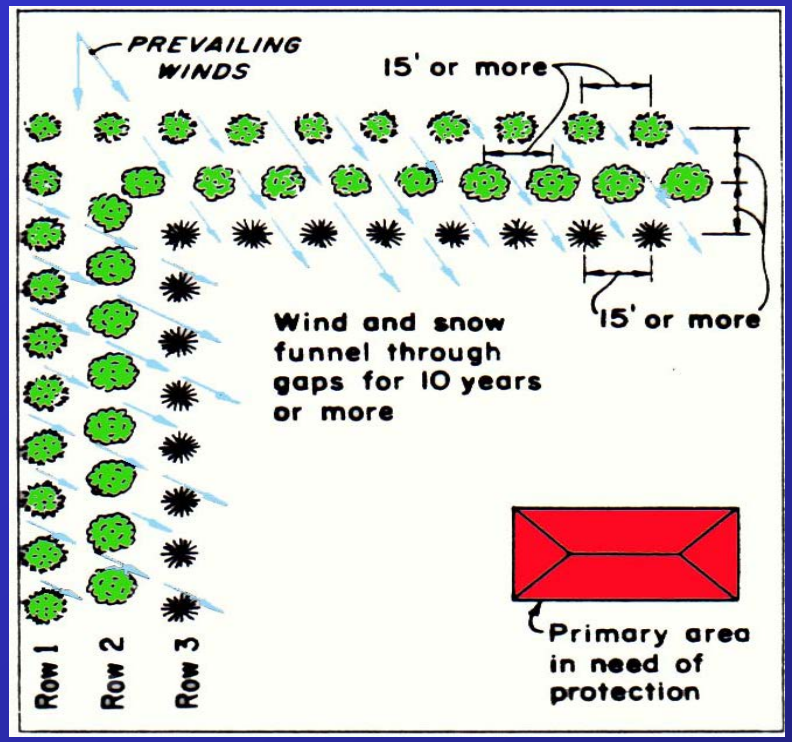


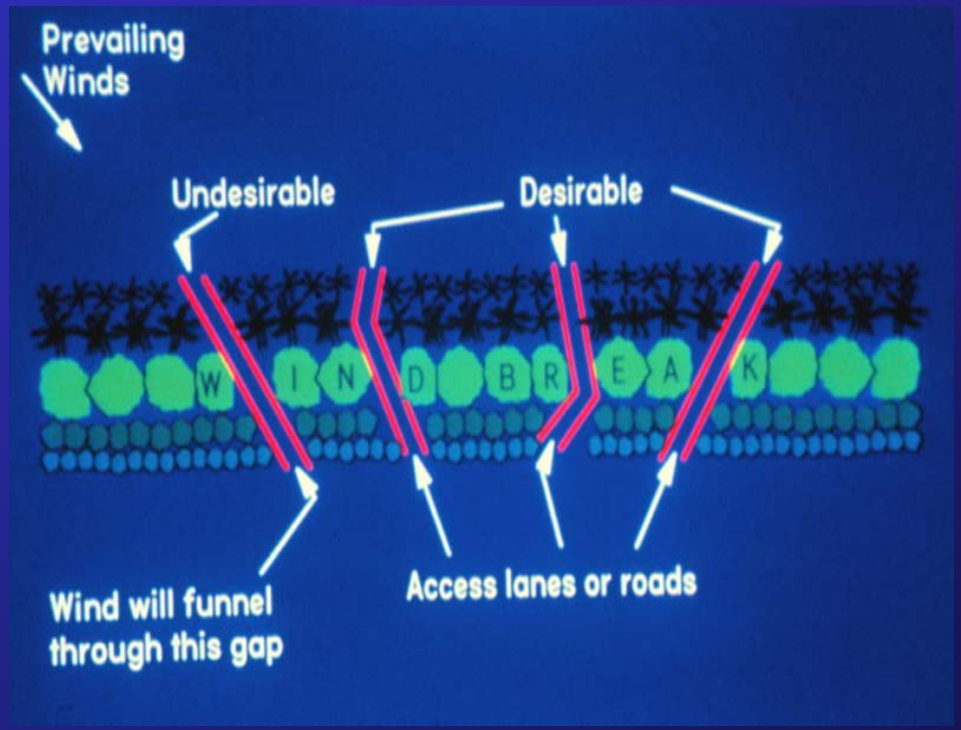
- Orient windbreaks perpendicular to troublesome winds
- Plan multiple windbreaks for whole field protection

Windbreak Length



Windbreaks Need to be Continuous





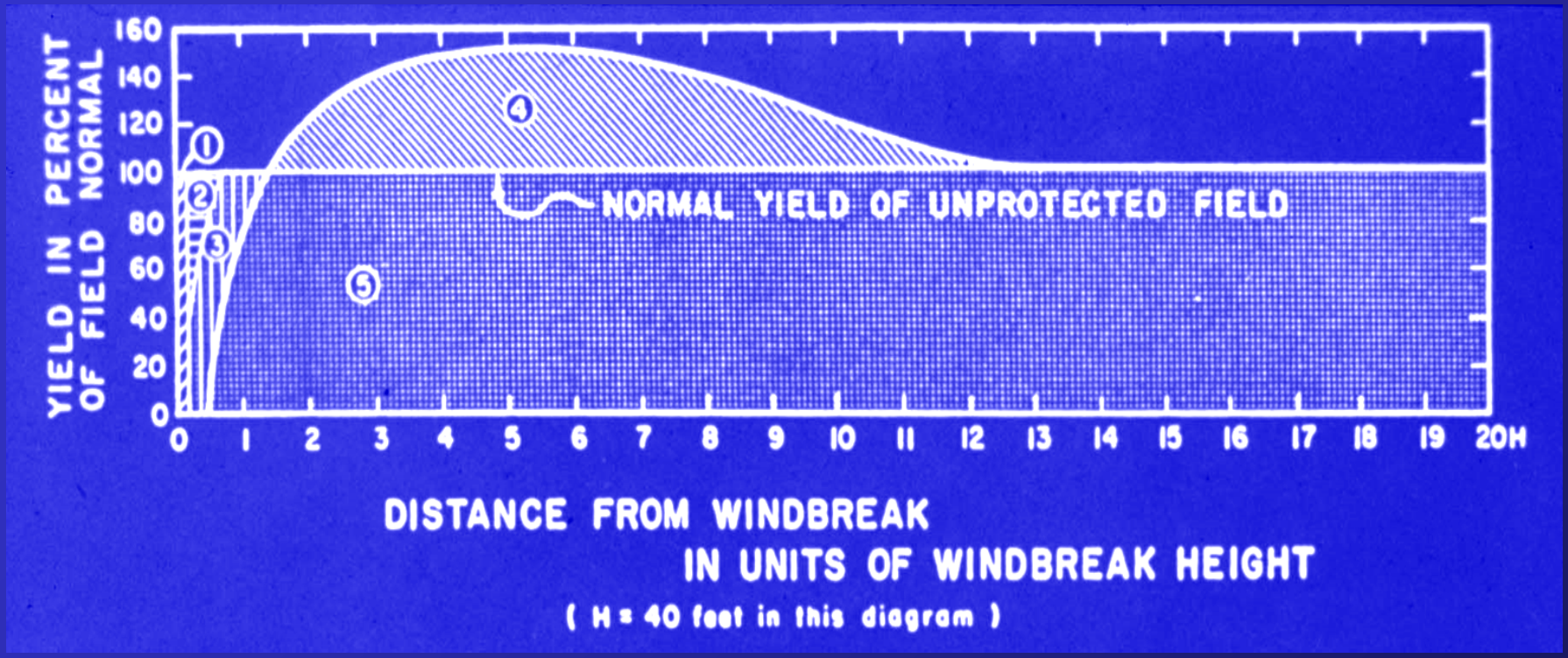
Avoid creating gaps in the windbreak

Windbreaks

To protect young crops from wind erosion

Field Windbreaks

Field Windbreak - Benefits



Weighted Average Crop Yield Increase:

Corn - 12%

Barley - 25%

Hay - 20%

Soybeans - 13%

Winter Wheat - 23%

Spring Wheat - 8%

(Kort, 1988)

Windbreaks

Windbreaks help prevent weight loss in cold weather and provide shelter for cattle

Riparian Forest Buffers

A combination of trees and other vegetative materials established on stream and river banks to regulate microenvironments and buffer these waterways from non-point source pollution from adjacent land use.

Because of watershed modifications *Riparian Forest Buffers* are needed

Often *no perennial riparian vegetation* is left & riparian buffers/filters have to start from scratch

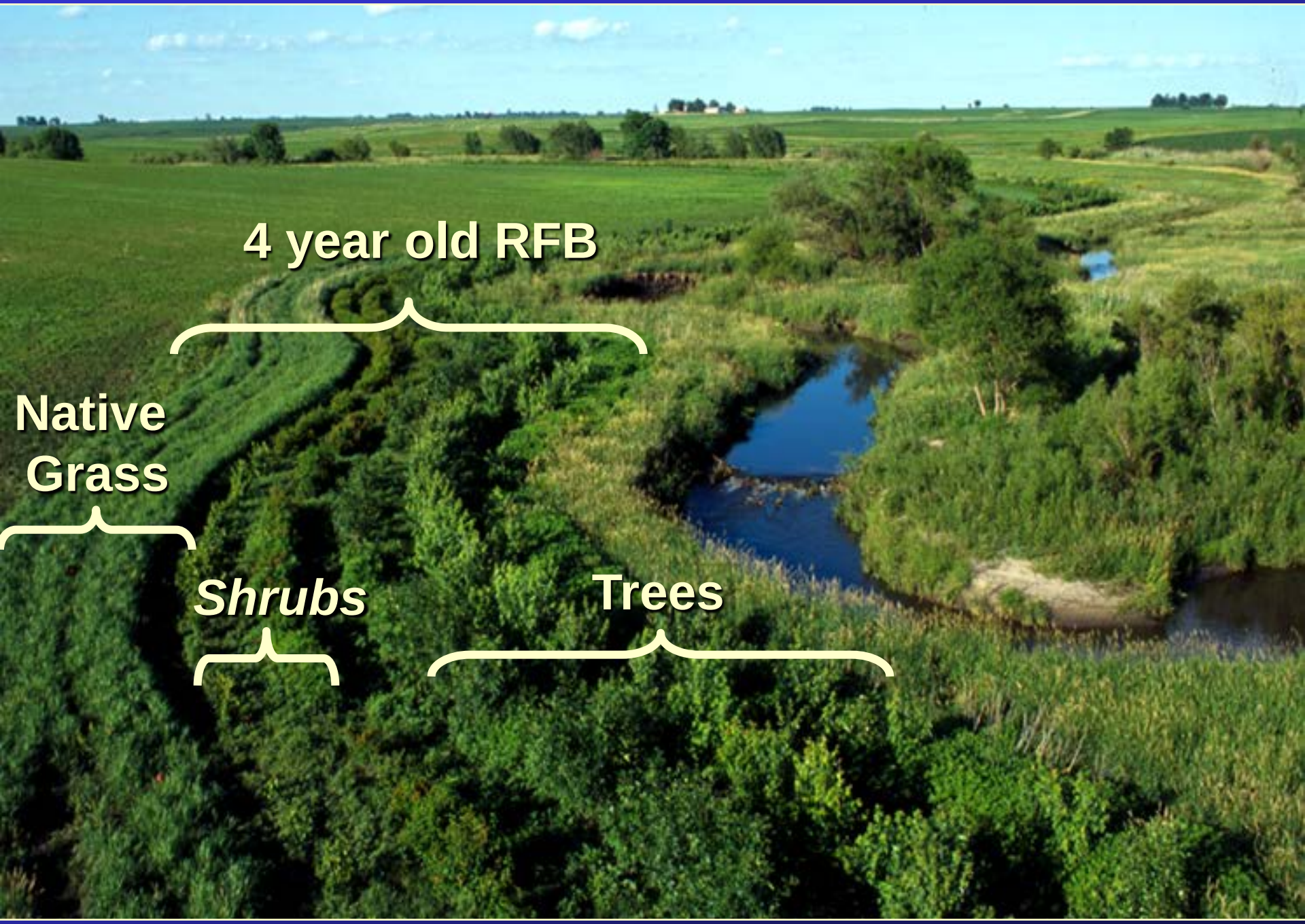
Riparian Forest Buffers

Year 5

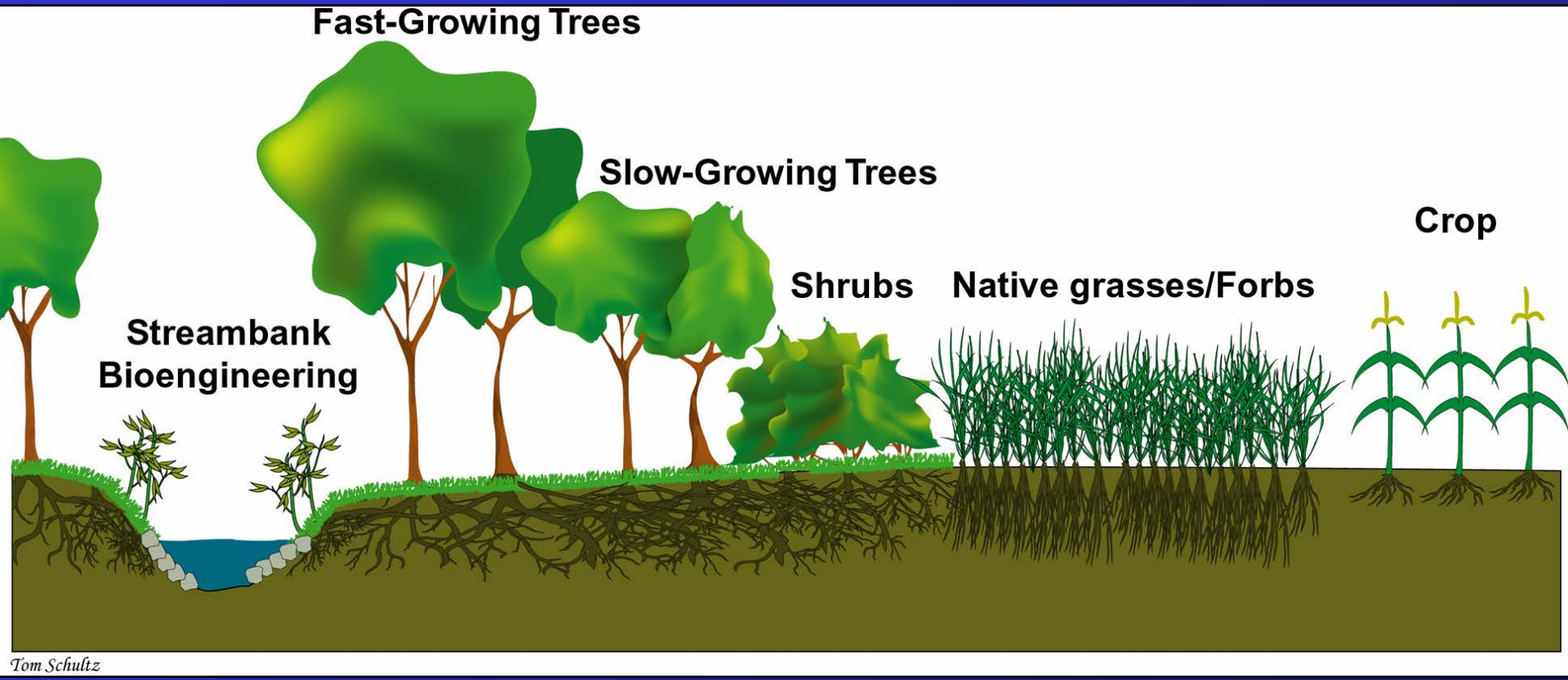
Riparian Forest Buffers

1990

1994


4 year old RFB
Native Grass
Shrubs
Trees

Riparian Forest Buffer



Planned combinations of trees, shrubs, grasses, forbs & bioengineered structures designed to mitigate the impact of land-use on a stream or lake.

Benefits of Forested Riparian Buffers

- Filter sediment, nutrients and pesticides
- Helps prevent stream bank erosion
- Provides income potential
- Develop and improve wildlife habitat
- Protects aquatic habitat
- Protects against flood damage

Woody Florals – A “Cash Crop”

- **Crop to diversify agricultural system**
- **Protect and enhance environment**
- **Help address non point source pollution problems**
- **Good markets**
- **Rapid growth and reasonably quick return on investment**
- **Low capital costs**
- *Off season labor requirements*
- **Can be grown in riparian forest buffers, windbreaks, or alley cropping configurations**

Woody Florals in Windbreak Plantings

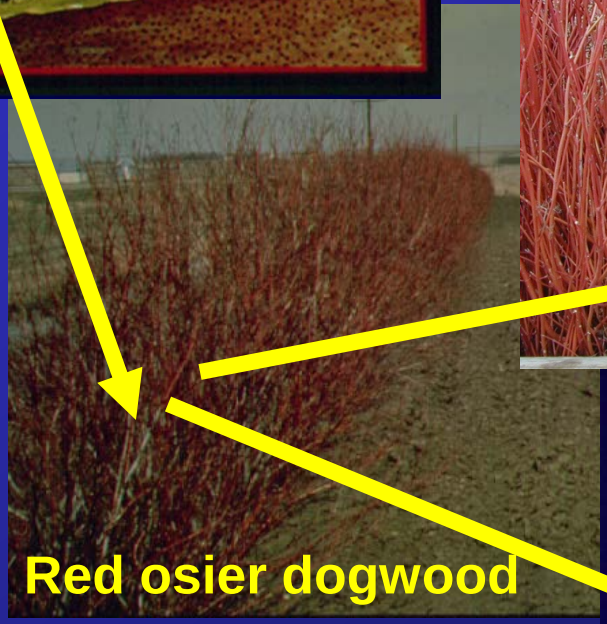
Red Twig Dogwood – Photo: Scott Josiah, UNL

Riparian Forest Buffers and Income Generation

Woody florals

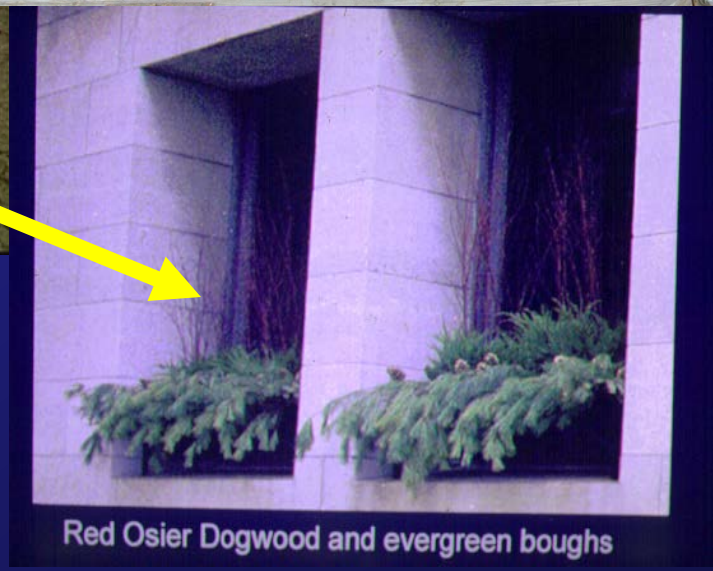
Shrubs with market value

$0.35 – $0.45 *per stem* wholesale



Red osier dogwood

Cornus stolonifera



Red Osier Dogwood and evergreen boughs

Forest Farming

- …the intentional manipulation of the forest canopy to improve the forest stand and produce understory crops

Extra Value of *Forest Farming* and *Silvopasture*

- currently Missouri Forest Products Industry generates $4.3 billion per year

- less than 5% of our 14 million acres of forest land is under management

- practices, such as forest farming and silvopasture, can significantly increase acreage under management and greatly increase the value of our future forest industry.

Thinning to create the Forest Farm

Before Tree Removal

After Removing 20%

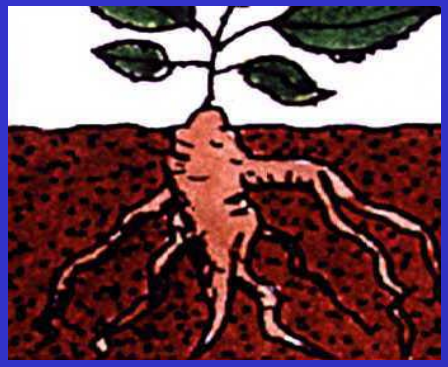
Forest Farming

Growing shiitake mushrooms under the forest canopy

FOOD - Edible Forest Mushrooms

- Shiitake
- Maitake
- Reishi
- Oyster

- Morels
- Chanterelles
- King Stropharia
- Honey Mushrooms
- Chicken-of-the-Woods
- Coral Mushrooms



Forest Grown Herbal Medicinals

Volatile Markets – market price data not easily located

- **American Ginseng**
- **Goldenseal**
- Witch Hazel
- Black Cohosh
- Bloodroot
- Saw Palmetto (Florida)
- Slippery Elm
- Elderberry Flowers
- Virginia Snakeroot

Floral, Landscape or Decorative Forest Products

Orchids of Missouri

- Of the 15,000 plus species of orchids, 34 species representing 16 genera are native to Missouri.

- 16 of the 34 species are found on the rare or endangered list for Missouri.





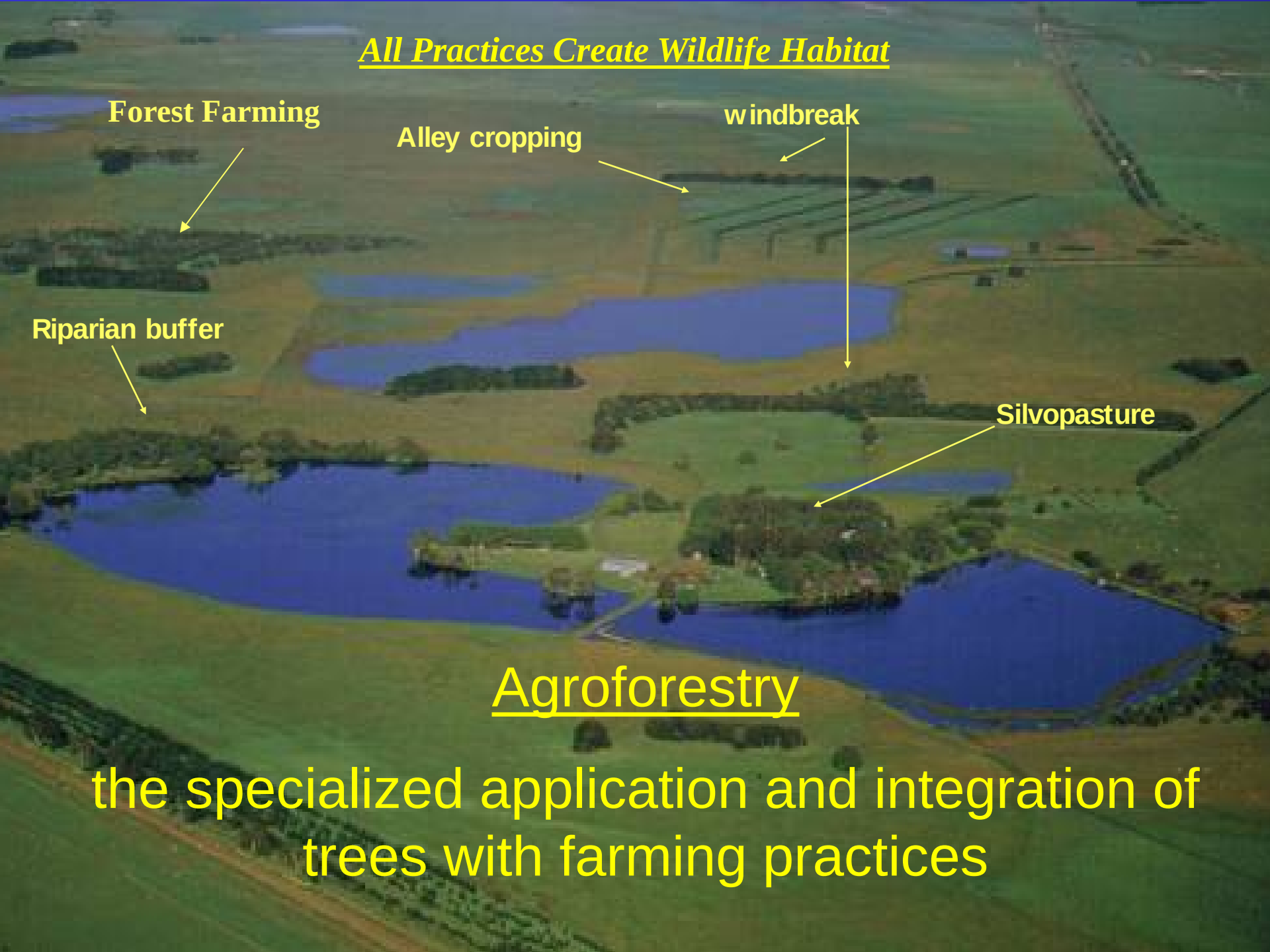







Successful Forest Farming

- Know how to grow/propagate the crop (Sustainability)
- Know what the consumer wants (quality)
- Know How and Where to sell the product (Packaging/Presentation & Marketing)



Agroforestry

the specialized application and integration of trees with farming practices