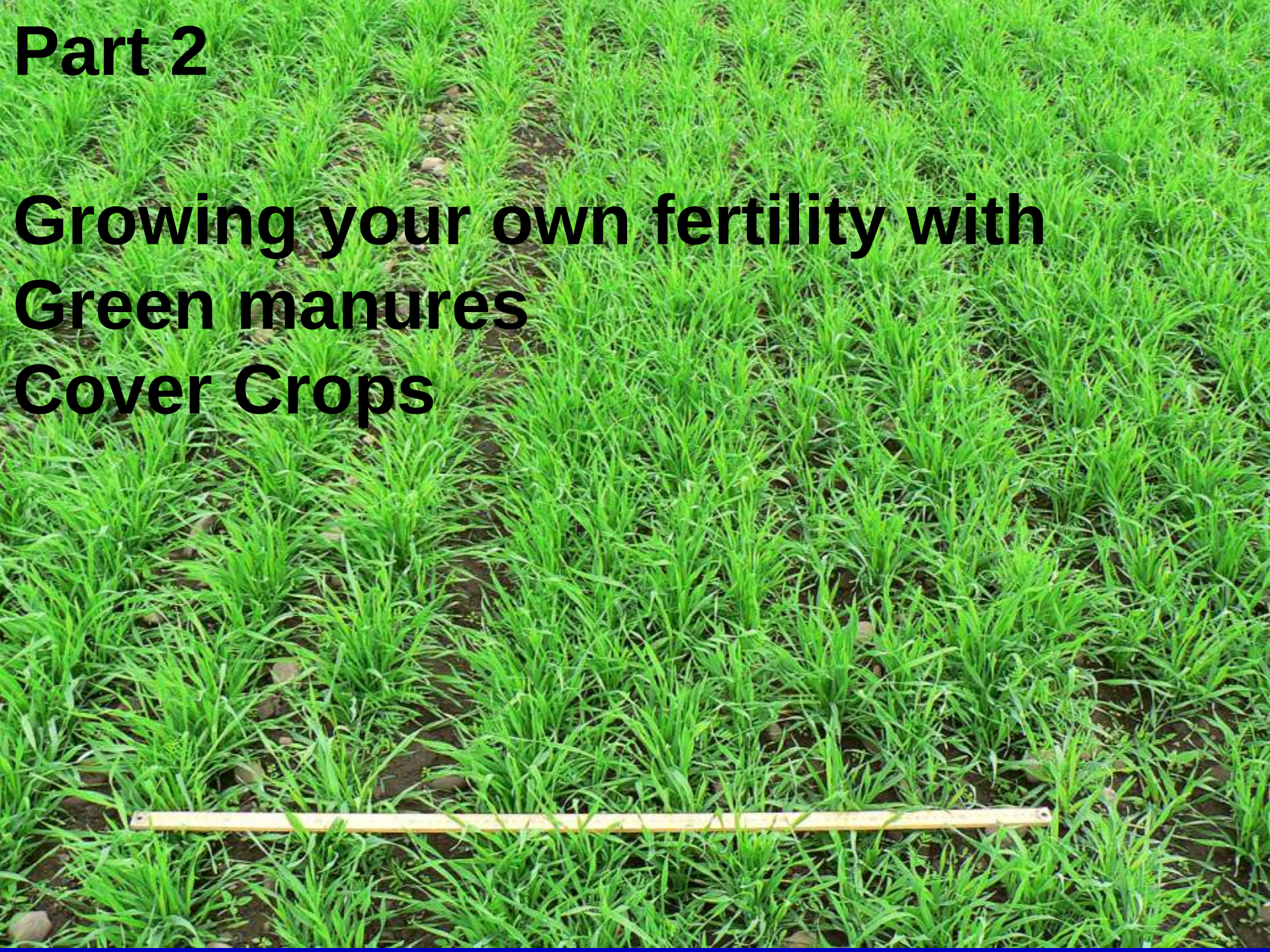
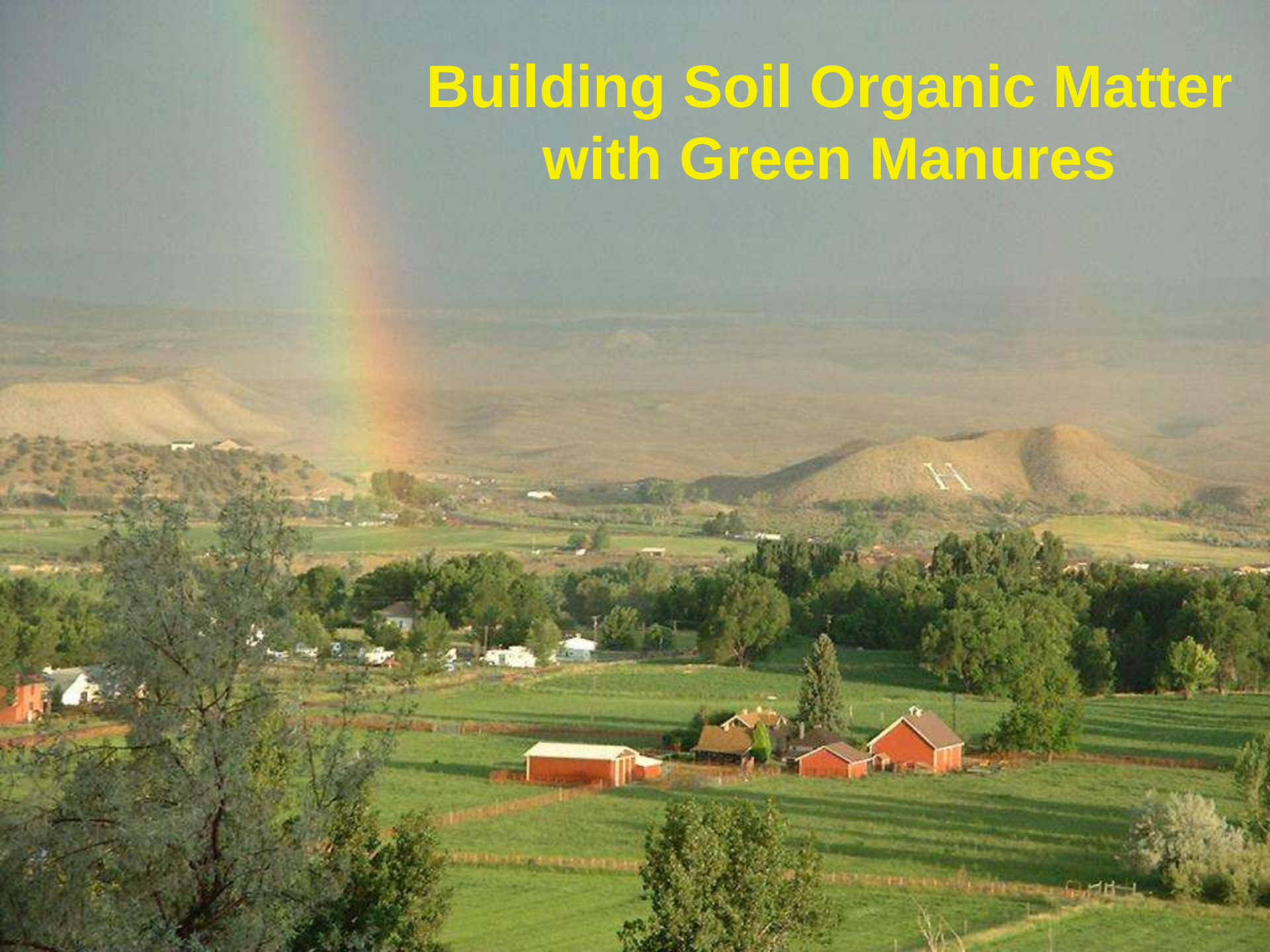

Part 2
Growing your own fertility with
Green manures
Cover Crops

Building Soil Organic Matter with Green Manures



Semantics

Green Manure Crop: grown to help maintain soil organic matter and fertility, tilled or mowed and left on top of the soil (tilled 60%, mowed 40%)

Cover Crop: grown mainly to reduce soil erosion by covering the ground with living vegetation and living roots that hold the soil.

Catch Crop: grown to retrieve remaining nutrients in the soil following a cash crop, prevents nutrient loss over the winter.

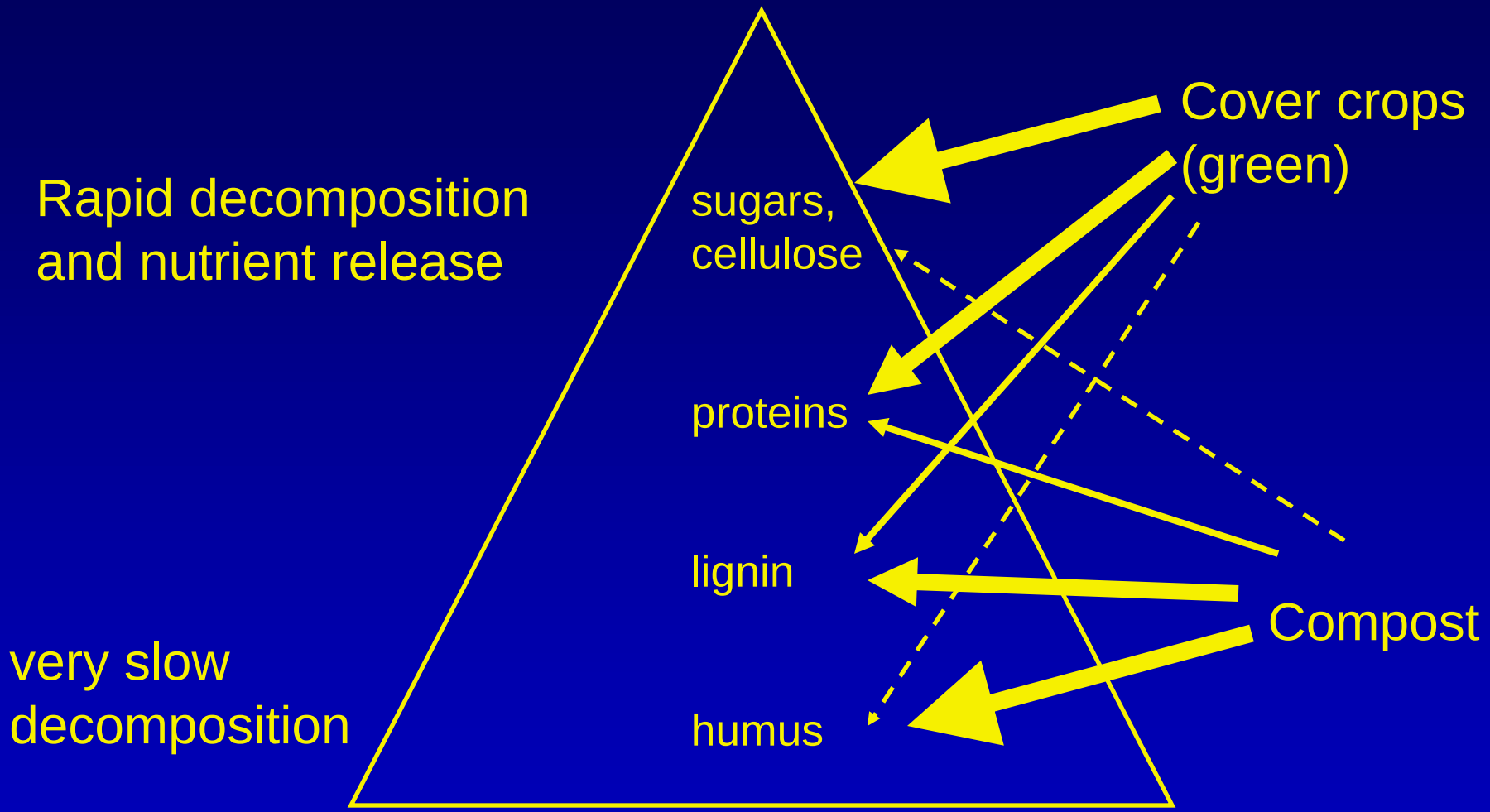
Green Manures

Why grow green manures?

When to grow a green manure crop

What green manure crops to grow

Effects of Residues –Green manures & composts



Adapted from Building soils for better crops

Why Grow a Green Manure Crop?

A. Primary Benefits (goals) of green manure
    1. Reduce the need for off-field OM & improve soil structure, tilth & water retention
    2. Legumes supply much of needed crop Nitrogen
    3. Break weed & insect pest cycles
    4. Improve soil biological activity
    5. Improve yields by enhancing overall soil health
B. Secondary Benefits
    1. Source of mulch
    2. Harvest possibilities for forage
    3. Seed production
    4. Livestock grazing

Different Types of Green Manures

Winter annuals – winter rye, barley, wheat, peas, white clover, hairy vetch….

Cool season annuals – oats, rye, subterranean clover..

Warm season annuals – buckwheat, cowpeas, sweet clover, berseem clover….

Perennials

Short lived – medics, red clover (biennial)

Long lived – white clover, alfalfa

Effect of Planting Date

Benefits of Growing Green Manures

Reduce the need for off-field OM additions & improve soil structure & tilth

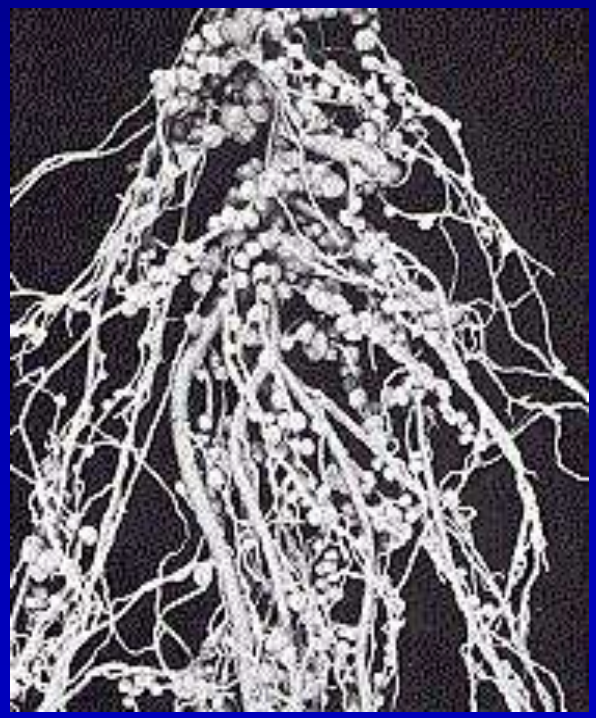
- **food for micro-organisms and improve diversity**
- **replenish active OM lost during cultivation**

Grow your fertilizer in the field!

Legumes supply much of the need N in symbiosis with

Rhizobia

- Rhizobia: soil bacteria responsible for symbiotic nitrogen fixation on legume roots.
- Rhizobia fixes atmospheric nitrogen for use by legume plants in exchange for food (sugars) from the plant that keep the bacteria living!
- Rhizobia are species specific and seed must be innoculate the first time it is planted.



Legume	Biomass tons/ac	Nitrogen lbs/ac
Sweet Clovers	1.8	120
Winter Peas	2.0 – 3.0	90 - 150
White Clover	1.0 - 3.0	80 - 200
Red Clover	1.0 – 2.5	70 - 150
Hairy Vetch	2.0 – 4.0	80 - 125

Crop	Tops (%N)	Roots (%N)
Peas	89	11
Clovers	68	32
Alfalfa	58	42

Adapted from MCCP

Adapted from P. Sullivan (attra)

Green Manures & Cover Crops break weed and insect pest cycles

CC & GM are integral in crop diversity & rotations

Weed management

suppress weeds by competing for

- light
- nutrients
- moisture

some also produce germination inhibitors

Cereal grain are excellent choices for suppressing late fall and early spring weeds & prevent winter erosion

Manipulating N supply with Green Manures

1. Green Manure Management
    a. N release dependent on temperature and soil moisture (95º F, field capacity)
    b. Timing of N release to crop need
    c. Manipulation of residue quality
        1. Early = green = fast decomposition
        2. Later = stems = slower decompostion
2. Residue Management
    a. The lower the C:N the faster the decomposition
    b. Legumes typically have low C:N ratios compared to non-legumes
    c. Mixing GMs – adding rye to legumes slows decomposition

Residue Management continued

4. Leaves decompose five times faster than stems
5. Soil incorporation speeds decomposition

Growth Management

1. Low plant populations increase stem content
2. Higher plant population increase leaf production
3. Leaves dominate early in growth cycle
4. Stems dominate later in growth cycle
5. When to cut GM critical to your objectives

Subsequent Crop Management

1. N release is dependent on decomposition
2. GM may represent source of slow release N
3. Surface applied residues encourage near surface rooting esp. when N release is high.

GM crops improve yields by enhancing soil health

Feed the soil that feeds the crops

Soil MO number and diversity increase rapidly after crop incorporation

During microbial breakdown nutrients are released

Crop	Biomass lbs/ac	N lbs/ac	P lbs/ac	K lbs/ac
Clover	4200	110	20	130
Winter Peas	4200	150	20	160
Rye	5600	90	20	110

Plan Ahead

MAKE A FARM PLAN!!!

For crop nutrient requirements

Manure additions

- animal
- green

Compost additions

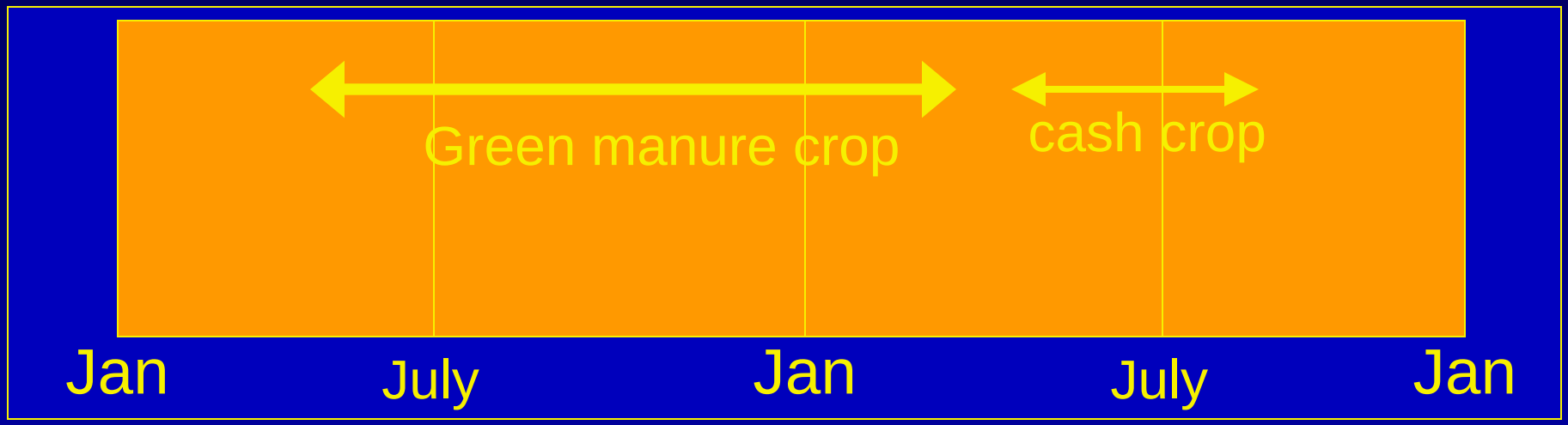
Crop rotations 4 – 5 years minimum

Cover crops & mulches!!!!

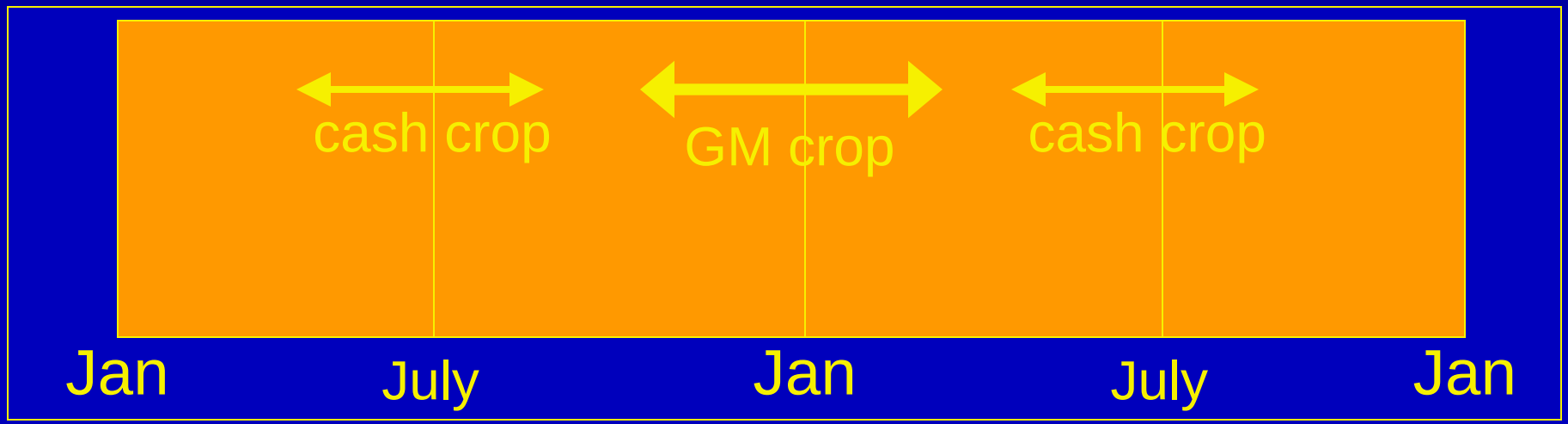
DON’T Guess SOIL TEST!!!

Field timeline examples for green manure for farm plans

South 40



Back 40



Adapted from Building soils for better crops.




Putting it all together

1. Know Your Soils
    a. Soil Characteristics
    b. Soil Texture
2. Know Your Crop Nutrient Needs
    a. Essential Plant Nutrients
    b. Soil pH & Nutrient Availability
    c. Soil Sampling & Testing
    d. Spotting nutrient deficiencies
3. Grow green manures in your rotation
4. Manage organic matter to improve soil quality to grow high quality crops!


Questions?


Thank you!
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What GM Crop to Grow

Selecting the best crops for your farm

- Clarify primary needs
- Identify the best time and place for crops in your system
- Test a few options

What is your primary need?

a. Provide nitrogen
b. Nutrient mining
c. OM additions
d. Improve soil structure
e. Reduce soil erosion
f. Provide habitat for beneficial insects
g. Manage nutrients

Secondary needs?

a. Better drainage
b. Mulch production

When to Grow GM Crops

What's the best time to grow GM crops in your system

Make a rotation time line for each field (18-24 months)

Show

1. Seeding time
2. Harvest time
3. Fallow periods

Look for:

open periods in each field

opportunities in your work schedule

Examples: Winter fallow

Summer fallow

Small grains (winter & spring)

Full season fallow

Organic Matter Application Rates

Material	App. Rate tons/ac	N lbs/ac	P lbs/ac	K lbs/ac
Compost	5	200	100	150
Dairy	5	200	100	300
Poultry	5	350	450	200
Alfalfa (early)	5	200	50	250

Plan Ahead

MAKE A FARM PLAN!!!

For crop nutrient requirements

Manure additions

- animal
- green

Compost additions

Crop rotations 4 – 5 years

Cover crops & mulches!!!!!

DON’T Guess SOIL TEST!!!

Web Resources on Cover Cropping/Green Manures

USDA's Sustainable Ag Network (SAN)
Managing Cover Crops Profitably
Building Soils for Better Crops
www.sare.org/publications

Appropriate Technology Transfer for Rural Areas
ATTRA
www.attra.ncat.org

Cover Crops on the Intensive Market Farm
www.cias.wisc.edu

Organic Matter Management

Strategies

1. Increase additions of organic residues to soils
   a. Boost initial OM additions in first year or two
   b. Reduce OM additions to maintain soil OM in following years according to soil test
2. Use a variety of sources of organic materials
3. Decrease losses of organic matter from soils
   a. Reduce tillage
   b. Reduce erosion

Raise & maintain soil organic matter

- Requires a sustained effort
- Difficult in sandy soils, easier in clayey soils
  - Raise the rate of OM addition above decomposition
  - Reduce the loss through mulching & reduced tillage
- How much OM is enough?
  - Sandy soil – 2% is very good
  - Clayey soil – 3 – 4% is good

Management practices that improve OM content

- Off field additions
  - Manures, composts, green manure
- Crop residue utilization*** cover or mulch
- Include high residue crops in rotations
- Include grass/legume crops in rotations
- Grow cover crops
- Reduce tillage
- Use conservation practices that reduce erosion

Carbon:Nitrogen Ratios

Material	C:N
Clover & Alfalfa (early)	10:1
Poultry manure	10:1
Compost	13:1
Dairy manure	17:1
Alfalfa hay	20:1
Rye (green)	35:1
Corn stover	60:1
Wheat, oat, rye straw	80:1
Sawdust	400:1
Optimum	20:1 or less

Organic Matter Application Rates

- Typically based on nitrogen contribution to succeeding crop
  - Excess N is typically lost from the system
  - Sometimes based on P requirements of succeeding crop

- Residue decay

Year 1	Year 2	Year 3	Year 4
50%	15%	5%	2%

Systems without manures

- Reduced tillage
- Cover crops (esp. legumes)
- Intercropping (overseeding)
- Mulches and living mulches
- Crop rotations (sod type crops)
- Strip cropping (mow & throw)

Soil Biodiversity

- Diversity is THE KEY!!!!
  - Where many different types of organisms exit there are fewer disease, insect or nematode problems.
- Promote diversity by: adding varied amendments
  - Cover cropping
  - Crop rotations
  - Intercropping

Minimizing Pest Problems

- Reduce insect damage by avoiding excess N
- Reduced leaf disease by using low N compost
- Reduce fungal and insects damage by lessening compaction
- Maintain pollen & nectar sources for beneficials
- Mycorrhizal fungi !!! Protects roots and aids in nutrient uptake
- Rye residue reduces weed seed germination
- High soil biological activity reduces weed seed numbers

Thank You!

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