FERTILIZATION

SUMMARY
FERTILIZATION

Organic fertilization:

- Ruminant manure
- Chicken droppings
- Biochar

Mineral fertilization:

- Synthetic and mineral fertilizers
- Human urine

Fertilization by plants:

- Grain legumes
- Green manures: legumes
- Green manures: grasses
- Green manures: leguminous trees

ORGANIC FERTILIZATION - CN RATIO

- [C] / [N]
  - C concentration / N concentration
- High: high carbon, low nitrogen (C/N > 20)
  - ➢ Nitrogen starvation: the plant does not grow well because of lack of nitrogen
- Low: a lot of nitrogen, little carbon (C/N < 15)

  Priming effect: accelerated mineralization → loss of MOS → loss of fertility
- 15 < C/N < 20 : ideal: need of nitrogen covered to allow a good decomposition of the carbonaceous matter

ORGANIC FERTILIZATION

COW, SHEEP AND GOAT MANURE

- Excellent fertilizer
- Contains all nutrients in a balanced way
- Contains a lot of OM → maintains soil fertility

For quality manure:

- Keep in a concrete pit protected from rain
- Cover with a tarp
- Feed animals with quality fodder
- Keep animals in pens for easy manure collection
- Mix soil with manure immediately CN ratio
- Fresh manure with straw: 30
- Fresh manure without straw: 20
- Decomposed manure (2-3 months): 10

ORGANIC FERTILIZATION

CHICKEN MANURE

- High quantity of basic cations (K+, Ca2+, Mg2+) → reduces soil acidity
- Very fast decomposition and high concentration of nutrients
- Can be used almost as a mineral fertilizer in rainy season
- Contains a lot of OM → maintains soil fertility

For a quality manure:

- Same as cattle manure

CN: 10

CAUTION: High concentration of basic cations.

Risk of soil destabilization: erosion

DO NOT EXCEED 10 T/HA

Fertilization: composting

Insulate the sides and protect it from the rain

Store it on the ground so that worms, insects and fungi can access it.

1. Place straw on the ground to optimize aeration (20 cm).
2. Add 10 cm of kitchen waste (no animal waste, especially bones, blood). (CN low)
3. Add 20 cm of leafy waste (stylosanthes, brachiaria, vegetable biomass) chopped into small pieces (2-5 cm). (CN high)
4. Water lightly to moisten.

Fertilization: composting

5. Repeat 2-3-4 until desired height is reached.

6. Place straw on the pile.

- Water every 3-4 days.
- Every 10 days, turn the pile, mixing all layers.
- Compost is ready for use when it is black and looks like soil (2-3 months).
- CN: mature compost: 15

Fertilization: compost: building the compost bin

1. Excavate 30 cm

Fertilization: compost: building the compost bin

2. Build the superstructure and place it in the pit. The superstructure must be 60 cm above the ground.

MINERAL FERTILIZATION - SYNTHETIC AND MINERAL FERTILIZERS

- Produced by industry
- Mineral fertilizers: contain only nutrients in mineral (non-organic) form
- Nutrients directly available to the plant, which allows a quick and efficient effect on growth and final yield
- Nitrogen (N) and phosphate (P) fertilizers can greatly improve the yield of certain crops, mainly cereals and vegetables
- Potassium (K) fertilizer is important for vegetables like tomatoes

MINERAL FERTILIZERS: PROBLEMS

- Energy consuming (1-2 L gasoline/kg N) and polluting (8.6 kg CO2-equ/kg N) production
- Priming effect: mineral input supports decomposing microorganisms → loss of SOM → loss of soil fertility → need to fertilize → loss of SOM : **VICIOUS CIRCLE**
- Very soluble molecules
  - →Risk of leaching → uselessness of the input and water pollution
  - →High fixation of P → uselessness of the input

For these different reasons, and particularly in the tropics where rainfall is intensive and soils are likely to fix phosphorus very strongly, it is essential to use mineral fertilizers in combination with an organic input.

MINERAL FERTILIZERS: TIPS

- Always apply mineral fertilizer in combination with organic fertilizer
- Avoid applying on exposed soil
- Avoid applying during periods of heavy rain
- Preference for urea
  - Nitrates : very soluble, risk of leaching
  - Ammonium : risk of N volatilization and soil acidification
- Synthetic fertilizers are generally not authorized in organic agriculture

MINERAL FERTILIZATION: HUMAN URINE

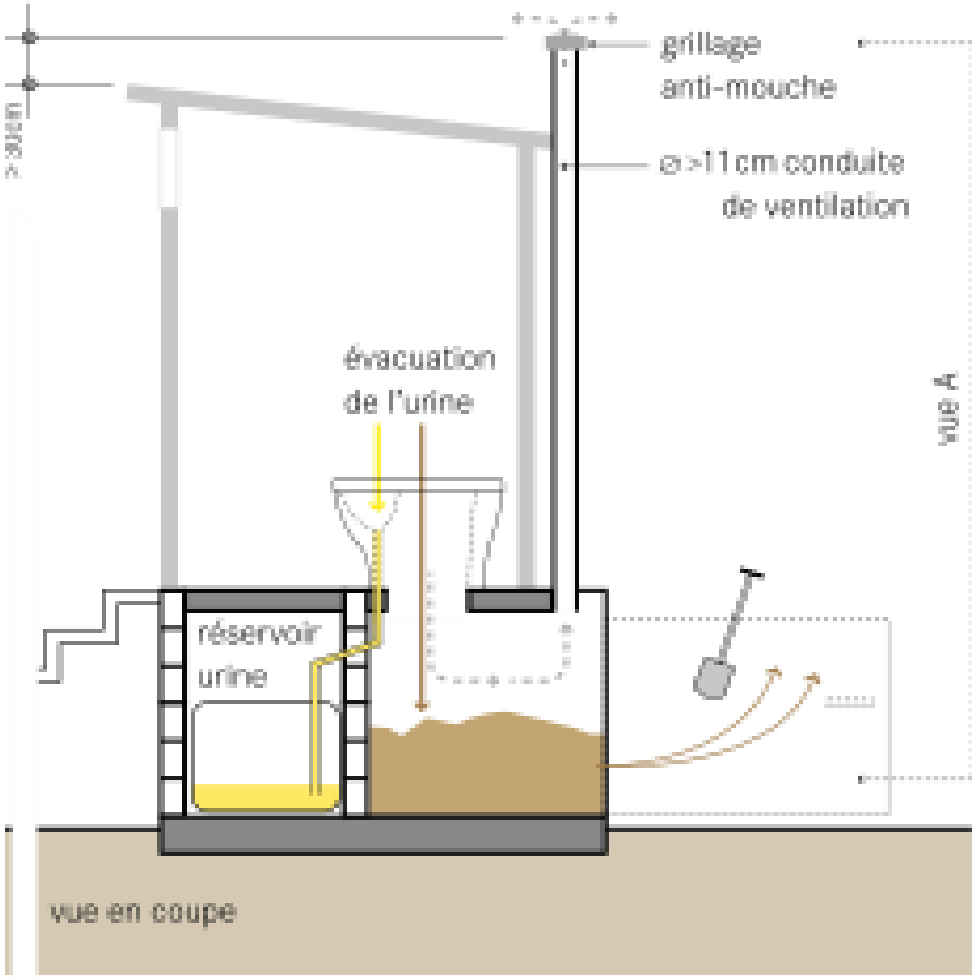
- Urine contains 80% of the Nitrogen and 55% of the Phosphorus that humans secrete.
- It also contains many minerals (Calcium, Potassium, Iron, Magnesium, Copper, Zinc).
- Therefore, recycling nutrients from urine has a strong potential to replace the use of synthetic fertilizers.
- The urine supply will provide the plants with the nutrients they need and thus prevent soil depletion.
- Urine, which contains nutrients in soluble form, like a mineral fertilizer, can be applied in a targeted manner in time and space.
- However, as urine contains no organic matter, it must be used in combination with an organic fertilizer.

HUMAN URINE - HYGIENE

The urine of a healthy person is sterile. Pathogens are found in the stool. It is therefore essential to follow the following rules to avoid contamination:

1. Urine must not come into contact with stool.
2. Urine from people who are ill or taking medication should not be used.
3. Urine must be stored for at least 3 months in a closed container before being used.

HUMAN URINE - HOW TO COLLECT IT?



HUMAN URINE - HOW TO APPLY IT?

- Mixed with organic fertilizer (compost or manure)
  - Enriches the organic fertilizer with nutrients.
- Watering at the foot of the crops.
- Targeted fertilization in space and time.
  - Since urine is very soluble, it should be applied regularly in small doses (1 x per 1-2 weeks).
  - Do not wet the leaves with the urine, as the salt and ammonium could burn them.
  - Dilute the urine by 4 with water.
  - Use for P demanding crops (cereals, legumes)
  - 1000 to 5000 L / ha

FERTILIZATION BY PLANTS

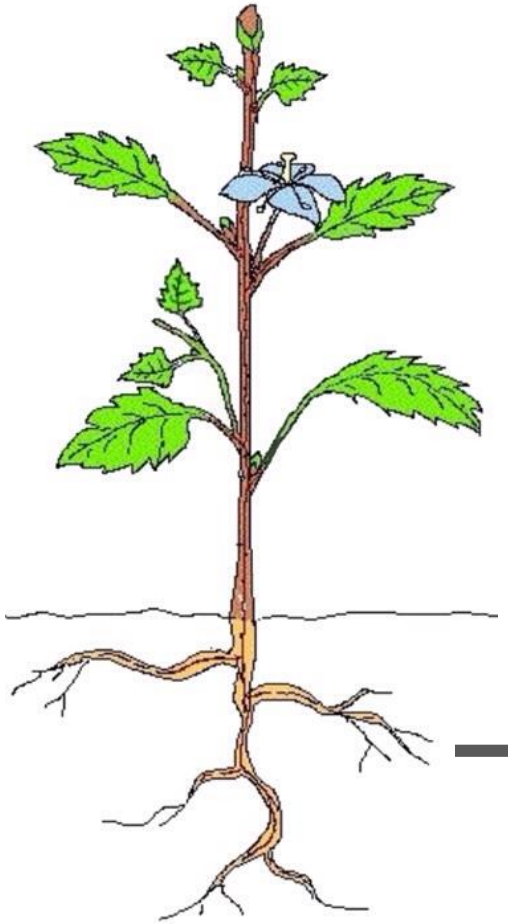
GREEN MANURE

- Growing crops to maintain/improve soil fertility
- Legumes: will fix nitrogen from the atmosphere: nitrogen input
- Legumes and others: Mobilize and assimilate other nutrients (P, base cations)

TYPES OF GREEN MANURES

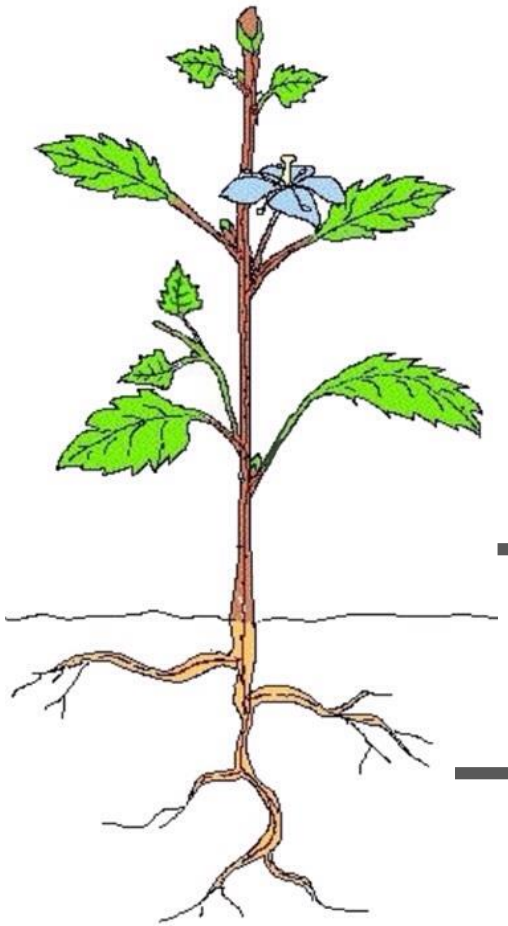
- Grain legumes
- Green manures: legumes
- Green manures: grasses
- Green manures: leguminous trees

HOW TO TRANSFER NUTRIENTS? - 5 WAYS



1. Root decomposition

HOW TO TRANSFER NUTRIENTS? - 5 WAYS



2. Composting

Compost

CN : 15

Soil

1. Root decomposition

CN : > 20

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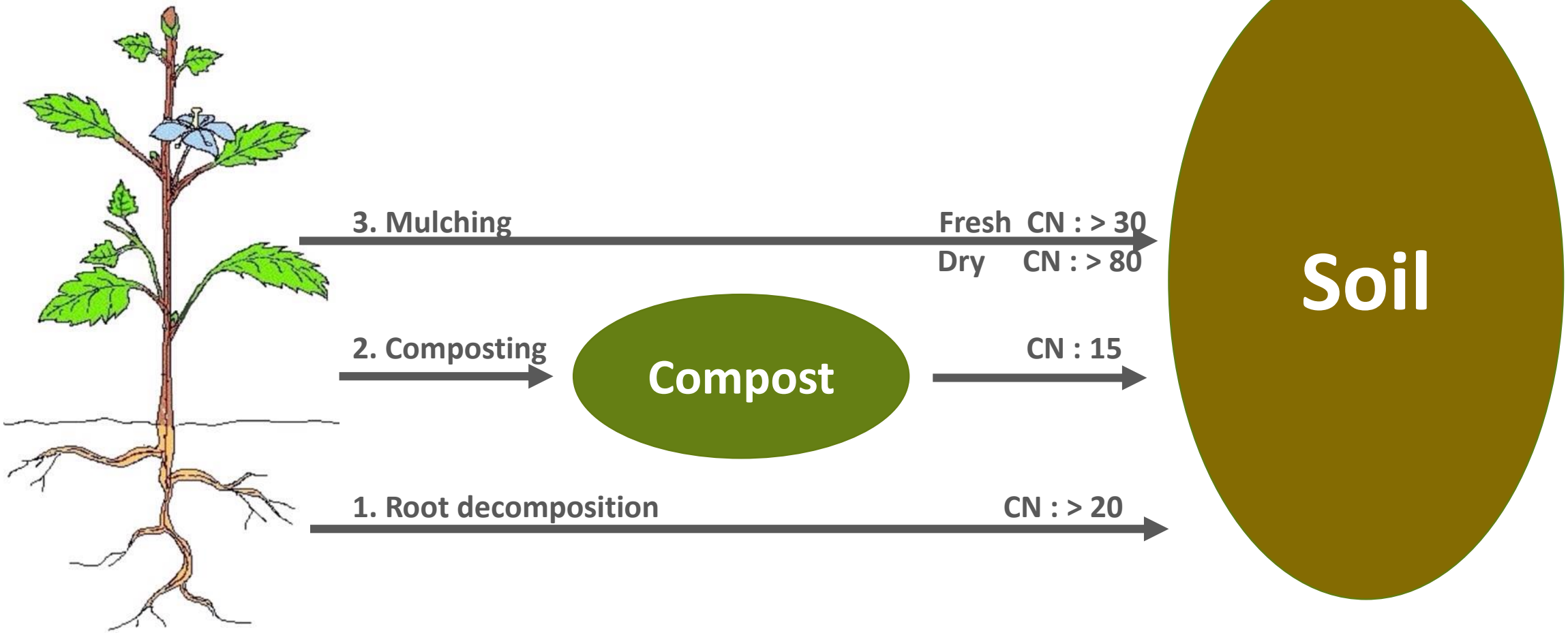

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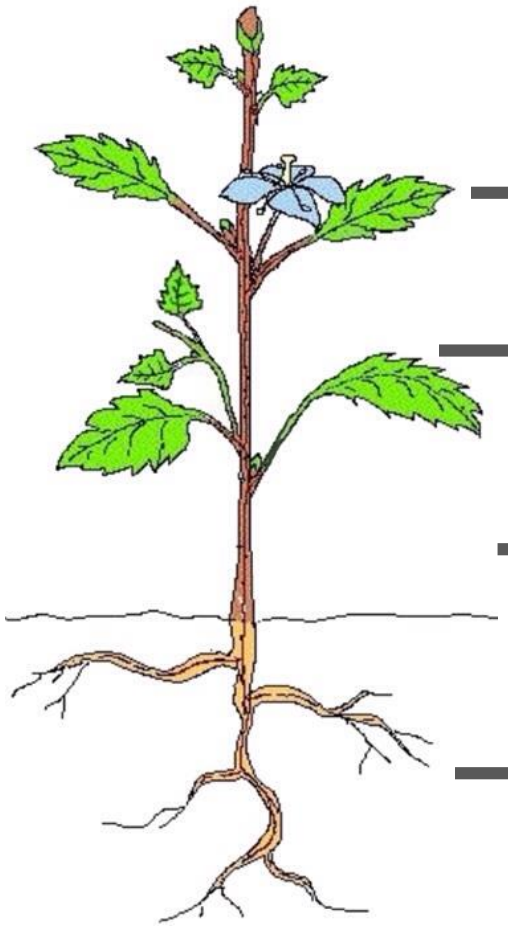


4. Fourage  Manure — Fresh CN : 20-30; Decomposed CN : 10-15

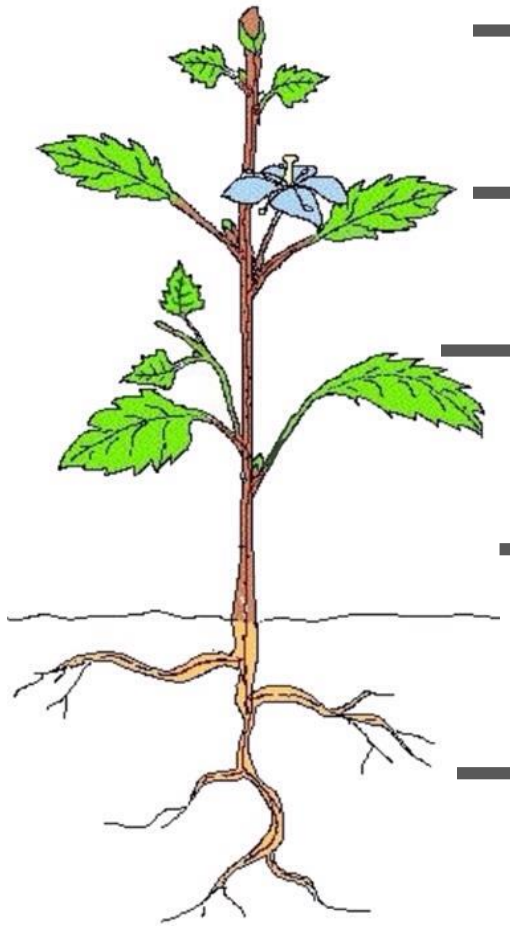
3. Mulching — Fresh CN : > 30; Dry CN : > 80

2. Composting → Compost → CN : 15

1. Root decomposition — CN : > 20

Soil

HOW TO TRANSFER NUTRIENTS? - 5 WAYS



5. Food

Urine

4. Fourage

Manure

Fresh CN : 20-30

Decomposed CN : 10-15

3. Mulching

Fresh CN : > 30

Dry CN : > 80

2. Composting

Compost

CN : 15

1. Root decomposition

CN : > 20

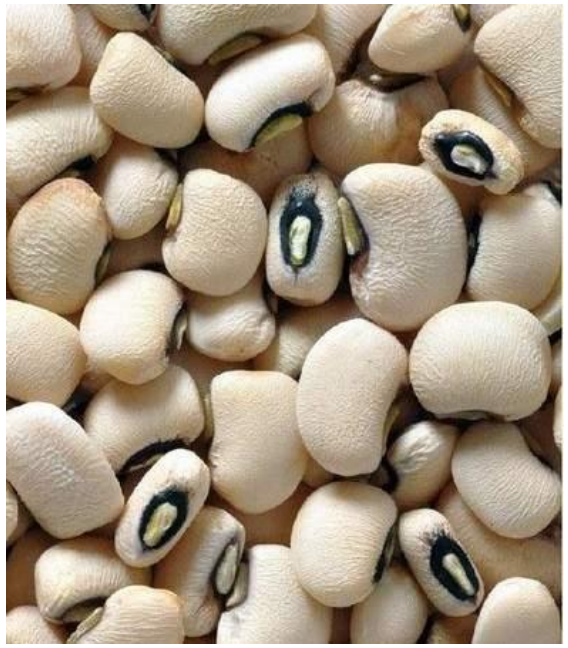
Soil

GREEN FERTILIZERS

GRAIN LEGUMES

- Produce edible grain
- No need to add nitrogen
- To improve soil fertility:
  - Root decomposition
  - Use stems and leaves as mulch
  - Use stems and leaves as compost
  - Feed stems and leaves to animals
    → produces manure

Less efficient than green manures



GREEN MANURES IN ROTATION

LEGUMES

- Higher soil enrichment potential with non-edible legumes
  - Stylosanthes, Mucuna, Desmodium
- Capture a greater amount of nitrogen
- Abundant biomass
- Fixed nitrogen, mobilized nutrients and biomass produced are not exported
- Important input of nitrogen and OM in the system
- Production of quality fertilizer
- Fresh N ratio: > 15

STYLOSANTHES

- Perennial legume
- Low water requirement
- Adapted to poor and acidified soils
- High biomass production
- Excellent dry season fodder
- High nitrogen fixation
- Strong root system
- Able to mobilize phosphorus and trace elements (B, Cu, Zn, Mn)
- Slow establishment

MUCUNA

- Adapted to moderately fertile soils, tolerates acidity
- High biomass production
- Rapid growth
- Toxic to humans and non-ruminants

CAJAN PEA

- Bushy perennial legume (0.5-4 m)
- Common names: pigeon pea, cajun pea.
- Climate: Any climate, tolerates drought.
- Soil: Any type of soil.
- Potential: Bush creation in a few months, high biomass and grain production, edible grains.
- Limitations: Not well suited to mixtures or grazing due to its bush formation.

DESMODIUM

- Adapted to all types of soil, tolerates acidity
- Pest control in grains
- Excellent fodder
- Toxic to humans and non-ruminants

GREEN MANURES IN ROTATION

GRASSES

- Do not fix nitrogen (with the exception of eleusine)
- Restructure the soil
- High biomass production
  - Increase soil OM content
- Mobilize soil nutrients (P and trace elements)
- Fresh CN ratio: > 40-50

PENNISETUM

- Perennial grass
- Adapted to all types of soil, tolerates acidity
- High biomass production
- Excellent fodder
- Suppresses weeds
- Powerful and deep root system → recycles nutrients and water from lower layers
- Mobilizes phosphorus
- Decompacts and restructures the soil → adapted for the regeneration of degraded soils
- Able to control pests in cereal crops
- Difficult to eradicate

BRACHIARIA

- Perennial grass
- Adapted to drought
- Adapted to all types of soil, tolerates acidity
- High biomass production
- Excellent fodder
- Suppresses weeds
- Strong and deep root system → recycles nutrients and water from lower layers
- Mobilizes phosphorus
- Decompacts and restructures the soil → adapted for the regeneration of degraded soils
- Able to control pests in cereal crops
- Difficult to eradicate

ELEUSINE

- Annual grass
- Adapted to medium fertile soil
- High and fast biomass production
- Low water requirement
- Excellent forage
- Edible seeds
- Strong and deep root system → recycles nutrients and water from lower layers
- Decompacts and restructures the soil → suitable for regeneration of degraded soils
- Able to fix nitrogen
- Easy to eradicate

GREEN MANURES

MIXTURES

For fodder production or grazing, it is recommended to mix different species.

- Reduces the risk of diseases or pests
- Increases the nutritional quality of the fodder
- Optimizes soil restructuring and regeneration

A legume-grass balance is essential for a quality forage: legumes provide the proteins missing in grasses, grasses provide the carbohydrates and fibers in low concentration in legumes.

GREEN MANURES

LEGUMINOUS TREES

- Leguminous trees that can be planted as hedges around crops:
  - Gliricidia, Sesbania, Calliandra, Leucaena, Cajan Pea, Acacia
- Roots draw water and nutrients from the deep layers of the soil
- Protect from climatic hazards and pests
- Produce fodder, mulch and transfer nitrogen from the atmosphere to the field

QUESTIONS