Forage Physiology and Soil Management for Small Farms

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Objectives
- Learn about the differences in forage species.
- Understand the basic anatomy of grasses.
- Learn about the life cycle of forages.
- Discuss how we can negatively or positively impact our forage base when implementing our grazing strategies.
- Discuss how basic soil analysis can help improve forage management.

Forages
- Many plants are used around the world as forages.
- These include:
  - Grasses
  - Legumes
  - Forbs
  - Shrubs

Not all forages are created equal

Forages can be:
- Annual
- Biennial
- Perennial
- Soil-forming
- Bunchgrasses
- Warm season
- Cool season
- C3
- C4

Not all forages are created equal

Annual
- Plants with annual life cycles complete their growth cycle in a single growing season (which is not usually an entire year), and are perpetuated by seed.
- The major row crop plants of the world:
  - Millet
  - Rice
  - Wheat
  - Barley

Not all forages are created equal

Biennials
- Plants that take two seasons or years to complete their growth cycle.
  1st season – Accumulate food reserves in storage organs.
  2nd season – Produces reproductive flowers and seed.
  - Some are root crops, such as beets, carrots, and potatoes, some for cover crops, and some vegetables like onions and cabbage are biennials. There are no common biennial grasses, but there are some weeds that fall in this category.
Not all forages are created equal

Perennial
- Plants that continue to grow indefinitely. Some may die back to the ground each winter (herbaceous perennials), but revive from the roots in the next spring.
  - Bermuda grass, bahiagrass, bluegrass, switchgrass, and sorghum; perennial peanut

Growth Habit

Sod-forming
- Strong, creeping rhizomes that extend through the soil or have stolons that grow above ground, producing new plants when they root at the nodes.
- New plants (shoots) develop either from buds in crown tissue of rhizomes and/or stolons.

Bunching
- Grow from tillers at or near the soil surface without rhizomes or stolons.
- New plants (shoots) arise from within the plant forming distinct clumps or tufts of vegetation.

C₃ vs. C₄

C₃ (cool season, temperate)
- Cool-season grasses are productive in the spring and fall because of the lower nitrogen uptake during the day and higher temperatures and often higher soil moisture. During the summer, growth is reduced and dormancy is induced by high temperatures.
- C₃ grasses in the rumen of an animal is often digested faster than C₄ grasses because of the thin cell walls and leaf tissue and are therefore often of higher forage quality.

C₄ (warm season, tropical)
- They are most productive during the warmer summer months. In central Florida, cool season and warm season are both used to provide forage throughout much of the year.
- C₄ plants can be annual or perennial. Annual C₄ plants include corn, Sudan grass and Pearl millet. Perennial C₄: Big bluestem, Guineagrass, Bermudagrass, Brachiaria (Muhlenbergia).

Plant Anatomy

Structures
- Leaves
  - Carbohydrate factories - organ that traps light and manufactures CHO used for:
    - Energy
    - Structure
    - Plant compounds
  - Shoot
  - Roots
  - Reproductive organs

Shoots
- A grass plant is a collection of tillers that grow buds at the base of the plant.
  - Tillers: stems of the plant that repeat themselves (branches).
  - True stems: leaf, stem node, axillary bud.
**Plant Anatomy**

**Structures**
- Leaves
- Shoot

**Roots**
- Xylem: Transport water, nutrients, and minerals to the leaves
- Phloem: Transport food from the leaves to other parts of the plant
- Nutrient Absorbers
- Plant anchor
- Reproductive organs

**Reproductive organs**
- Seedheads - They appear when the plant is mature enough to reproduce itself
- Some flowers do not produce viable seeds
- Corms - Underground runners that will develop into new plants
- Stems - Above-ground runners that will develop into new plants

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**Forage Lifecycle**

**Grass develops through a sequence of stages.**

**There are 4 primary developmental stages in grasses that you should be able to recognize for grazing management.**

**Stages**
1. Seeding
2. Vegetative
3. Jointing (elongation)
4. Anthesis

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**Forage Lifecycle**

**Stages**
1. **Seeding**
   - The grass plant has just emerged from the soil as a monopodial (one-leaf-type) structure. Legumes emerge with two leaf-like structures (dillionary).
   - Grass leaves may whorl and erect a "false stem", but the true stem has not yet formed.
   - Establishment period for seeded types: At this stage, the grass must begin to conduct photosynthesis for rapid growth, regrowth, and root system development.

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**Forage Lifecycle**

**Stages**
2. **Vegetative:**
   - Leaves continue to develop, emerge, unfurl, and die (permanent cycle).
   - The main function of the plant is photosynthesis.
   - This stage of development yields the best livestock food and managers should maintain this stage for as long as possible.
   - Environmental conditions will induce the next stage.

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**Forage Lifecycle**

**Stages**
3. **Jointing (internode elongation):**
   - Internodes commence elongation producing a true stem (culm). This elongation is preparation for seed development.
   - The stem is producing a peduncle that will anchor the seedhead.
   - Internodes elongate from the base of the plant producing a seedhead including the rudimentary seed head to a vulnerable height.
   - Removing the growing point late in this stage is advantageous for some grasses.
   - Stops the plant from expending as much energy on seedhead production.
**Forage Lifecycle**

**Stages:**

4. **Anthesis (Reproductive Stage):**
   - In this stage, the flowers are formed and the anthers are shedding pollen.
   - The plant’s work to produce the flower has resulted in decline of other functions, such as leaf production.
   - This stage (spike) is more liminous and plant palatability and digestibility decline.
   - The grass plant is ready for harvesting seed at this stage (and before) but is not desirable for livestock feed.

**Forages Need Nutrients**

**Macronutrients**

- N – essential element of chlorophyll (plant green) and amino acid structure (protein, enzymes, etc.)
- P – mineralization (phosphates, minerals, root development, energy storage, etc.), root development, flower development
- K – temperature regulation, plant energy conversion from storage, plant slimness

**Secondary Nutrients**

- Ca – cell wall strength
- Mg – photosynthesis
- S – protein creation

**Micronutrients**

- B, Cu, Fe, Cl, Mn, Mo, Zn.

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**A Dynamic Relationship**

**Our Soil:**

- Anchors our crops.
- Holds limited amounts of nutrients.
- Holds limited amounts of water.

- Is affected by management
  - Plant:Soil interaction
  - Plant:Animal interaction

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**Soil Health = Plant Health**

As livestock owners we should view ourselves as grass farmers.

**Good soil management practices include:**

- Appropriate stocking rate.
- Appropriate use of nutrients.
- Timely soil monitoring.
- Proactive approaches to balance the interaction:
  - Animals:Plant
  - Plants:soil

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**Grazing Impact**

**Proper grazing**

- Diminishes the competitive ability of plants like Bermudagrass and Smutgrass and improves the competitiveness of Bermudagrass, Bahiagrass and even clovers.

**Improper grazing**

- Can decrease the competitiveness of desirable species and encourage undesirable woody species.
Grazing Impact

Adequate Grazing

Optimal grazing time

Appropriate management

Proven curative

Happy Grass = Happy Livestock

Appropriate Management: Routine Soil Monitoring

- Nutrient amounts in the soil matches plant needs.
- Future nutrient applications match and do not exceed the needs of the plants.
- Monitor and correct soil acidity (pH) to ensure nutrient uptake.

Taking a soil sample

Fall sampling

- Lab results and nutrient recommendations may be returned more quickly because fewer samples are submitted.
- Allows you to apply the fertilizer when prices are generally lower.
- A field should always be resampled at the same time of the year so you can make historical comparisons.

Tools Needed

1. Soil Probe or trowel
2. Plastic Bucket
3. Soil Sample Kit

Pasture Sampling

An individual sample should represent no more than 10 acres.
- Considerations for sampling specific areas:
  - Past management
  - Cropping history
- Individually sample areas that have received different management or vary in soil type, have suffered erosion or that are different in topography.

Pasture Soil Analysis Protocol

- Soil sampling areas that are visually different can help you troubleshoot these areas and get information on soil composition variations.
- Collect at least 20 soil cores for small areas and up to 30 cores for larger fields.
- Randomly take the soil cores throughout the sampling area and place them in a plastic bucket.
Pasture Soil Analysis Protocol

- Do not sample:
  - Dung piles
  - Old fencerows or under trees
  - Areas used for manure or hay storage
  - Livestock feeding areas where lime was previously stockpiled

- Forages on average will utilize the first four (4) to six (6) inches of depth in our soil
- Take a core sample that is comprised of equal amounts of soil from zero (0) to six (6) inches in depth.

Pasture Soil Analysis Protocol

- Mix your cores together and remove all plant material and stones.
- Collect about a quart bag of soil and let it dry off completely.
- Fill in your information on the bag putting the soil in it.
- Match the information on your bag and the submittal form.

Submittal Forms

- Nutrient Testing for Bahia Pastures form.

Submittal Forms

What should I test for?

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Amount per 100 lbs of grass</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen</td>
<td></td>
<td>$15</td>
</tr>
<tr>
<td>2</td>
<td>Phosphorus</td>
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<td>$10</td>
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<tr>
<td>3</td>
<td>Potassium</td>
<td></td>
<td>$10</td>
</tr>
<tr>
<td>5</td>
<td>Manganese</td>
<td></td>
<td>$5</td>
</tr>
</tbody>
</table>

Submittal Forms

Nutrient Testing for Bermudagrass, Summer and Winter Annuals in Pastures Form.
Submittal Forms
Crop Codes:

Submittal Forms
What should I test for?

Basic Soil Test Report (Analysis code 1)
1. Soil Test Results and their Interpretations
   - Soil activity [pH]
   - Nutrient levels
   - Phosphorus [P]
   - Potassium [K]
   - Magnesium [Mg]
   - Calcium [Ca]

2. Lime and Fertilizer Recommendations

Summary
- Understanding our forages will promote make us better grass farmers.
- It is important to appropriately graze our pastures allowing time for our grasses to re-grow.
- Watch out for improper grazing. Pay close attention to the amount of time and intensity you graze your forages to ensure that our forages can come back year after year.
- Invest in regular soil analysis.

Upcoming UF/IFAS CFLAG Program

Visit the UF/IFAS Extension CFLAG Facebook page at:
https://www.facebook.com/UFIFASCFLAG/
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