Grazing For Soil Health

Greg Brann
State Grazing and Soil Health Specialist
Take time to develop a goal!

- Quality of Life
- Form of Production
- Vision of the future
SOIL HEALTH

• The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans.

• Soil Life:
  • Needs water
  • Needs food
  • Has a healthy temperature
  • Breathes and Respires
  • Has structure
  • Life span is dependent on management

• Functions:
  • Nutrient cycling
  • Water (infiltration & availability)
  • Filtering and Buffering
  • Physical Stability and Support
  • Habitat for Biodiversity

Strong Medium Granular Structure
Earthworm castings are 5x more fertile than surrounding soil
Plant Growth

• Dependent on past management
• Fertility
• Root Mass
• Leaf area
• Carbohydrate reserves in the stem
• Season and Environment
**INDICATOR PLANTS**

*Greg Brann, Grazing Soil Health Specialist*

Indicator Plants are plants that by their presence or abundance, provide an assessment of the quality of the site. Past soil management has a dramatic effect on the plant community and the plant community doesn’t change quickly so some indicator plants may persist after management has improved. Indicator plants provide insight to what is occurring below the surface but there are many factors that come into play such as previous land use or management. These can dramatically influence seed availability on the site (e.g. a low fertility site may still have broom sedge or rabbit tobacco on it even though fertility has improved). Soil testing, rest and recovery, more cover, increased diversity, seeding or other soil management methods may be required to alter the site to the desired state. The best weed control is out-competing undesirable plants. “Manage for what you want, not for what you don’t want. It takes grass to grow grass.”

<table>
<thead>
<tr>
<th>COMPACTED SOIL</th>
<th>OVER GRAZED LAND</th>
<th>WET OR FLOODED SOIL</th>
<th>LOW FERTILITY SOIL</th>
<th>DEFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Oxygen soils: Platy layers in soil, high bulk density (poor infiltration, increased runoff)</td>
<td>Lack of cover: Effects similar to compacted land — High weed population</td>
<td>Low Oxygen soils: Pore spaces become saturated or not present negatively affecting soil structure, decomposition, and chemical and biological processes</td>
<td>Unbalanced Fertility: pH below 5.1 (frequent) or above 7.3 (high pH is uncommon in TN). Often Phosphorus is limiting factor. Potassium is typically limiting on hay land</td>
<td>Severe deficiency of a nutrient or pH is low and infrequently too high in TN</td>
</tr>
<tr>
<td><strong>Prostrate knapweed:</strong> <em>Borago incana</em></td>
<td><strong>Horsenettle:</strong> <em>Solanum carolinense</em></td>
<td><strong>Sedges:</strong> <em>Carex spp.</em></td>
<td><strong>Rabbit tobacco:</strong> <em>Solanum americanum</em></td>
<td><strong>Nitrogen</strong></td>
</tr>
</tbody>
</table>

- **Rushes:** *Juncus spp.*
- **Bitter sneezeweed:** *Heliotrope amaranthum*
- **Rushes:** *Juncus spp.*
- **Red sorrel:** *Rumex acetosella*
# Soil Test Report

**GREG BRANN**  
853 PASADENA DRA  
NASHVILLE, TN 37204

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**Date Tested:** 11/15/2016  
**Lab Number:** 533393

### County: Davidson

#### Mehlich 1 SOIL TEST RESULTS and RATINGS (Pounds Per Acre)

| Water pri Value | P | K | Ca | Mg | Zn | Fe | Mn | B | Na | S
|-----------------|---|---|----|----|----|----|----|---|----|---
| riotic. Soluble. Saty. | 5.7 | 7.6 | 9 | L | 120 | M | 940 | 58 | 102 | 5
| Organic. Soluble. | | | | | | | | | | 3.3%

### RECOMMENDATIONS

**NEWLAND**  
Fertilizer/Lime Application Rate and Timing

- **Grass-Clover Pasture Establishment/Renovation**  
  - N/P/K/O: 30/90/60 pounds per acre
  - Limestone: 2 tons per acre
  - If renovation involves the addition of legumes to grass pastures, the nitrogen should be omitted.

- **Grass-Clover Pasture Maintenance**  
  - N/P/K/O: 0-90/60/30 pounds per acre
  - Limestone: 2 tons per acre
  - The nitrogen should be omitted on pastures containing more than 30 percent clover in the spring, otherwise if clover is less than 30 percent of the pasture apply 30 pounds of nitrogen per acre between March 1-30. For fall stocking or rescue apply 60 pounds of N per acre August 15 to September 15 to all rescue-clover mixtures.

Apply recommended amounts of phosphorus and potash in one application anytime during the year. If more than 4 tons of lime per acre are required, apply only 4 tons of lime per acre and re-test after one year.

**County: Davidson**

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#### Mehlich 1 SOIL TEST RESULTS and RATINGS (Pounds Per Acre)

| Waterpri Value | P | K | Ca | Mg | Zn | Fe | Mn | B | Na | S
|-----------------|---|---|----|----|----|----|----|---|----|---
| riotic. Soluble. Saty. | 4 | 3 (1.3) | 22.58 | | | | | | | |
| Organic. Soluble. | | | | | | | | | | |

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See back of this report for interpretation and detailed explanation of results and recommendations.  
If you have questions about this report, please contact us or your County Extension Office.  
Visit us on the web at ag.tennessee.edu/soil or Facebook at SoilFarm PestCenter.
Explanation of Soil Test Report

Recommendations in this report are based upon research data collected under various soil conditions and cropping systems throughout the state by University of Tennessee Research and Education Centers and Extension personnel.

Soil Test Ratings and Results

Phosphorus (P) and Potassium (K)

LOW (L) - In most cases, plants will respond to the application of this nutrient. If the nutrient is not applied, deficiency symptoms may occur in crops and usually yield less than 75 percent of their potential.

MEDIUM (M) - Plants may or may not respond to the application of the nutrient. Deficiency symptoms are not likely and yields can be expected to produce 75 percent or more of their potential without application of the nutrient.

HIGH (H) - The soil will produce at or near 100 percent of its potential without the addition of the nutrient.

VERY HIGH (V) - Supply of the nutrient in the soil is well in excess of the amount needed to produce 100 percent of the soil's potential. Application of the nutrient is not recommended. Since further additions may create nutrient imbalances.

Soil Test Ratings and Pounds per Acre - Phosphorus (P) and Potassium (K)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Phosphorus (P)</th>
<th>Potassium (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW (L)</td>
<td>0 - 18</td>
<td>0 - 90</td>
</tr>
<tr>
<td>MEDIUM (M)</td>
<td>19 - 30</td>
<td>91 - 180</td>
</tr>
<tr>
<td>HIGH (H)</td>
<td>31 - 120</td>
<td>181 - 320</td>
</tr>
<tr>
<td>VERY HIGH (V)</td>
<td>121+</td>
<td>321+</td>
</tr>
</tbody>
</table>

Secondary and Micronutrients

SUFFICIENT (S) - Indicates an adequate supply of the nutrient is available in the soil and a plant response to its use would not normally be expected.

DEFICIENT (D) - Indicates an inadequate supply of the nutrient is in the soil and application of the nutrient is recommended.

Soluble Salts

The soluble salts test refers to the potential for harmful effects due to the concentration of salts present in the soil. Soluble salt levels should be in the very low to medium range.

Higher levels may indicate over-fertilization or a poor drainage situation which allows accumulation.

General Soluble Salt Ratings and Interpretations

<table>
<thead>
<tr>
<th>ppm³</th>
<th>Rating</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 360</td>
<td>Very Low</td>
<td>Salt effects mostly negligible. Field crops mostly unaffected.</td>
</tr>
<tr>
<td>361 - 1060</td>
<td>Low</td>
<td>Field crops mostly unaffected.</td>
</tr>
<tr>
<td>1061 - 1760</td>
<td>Medium</td>
<td>Field crops mostly unaffected.</td>
</tr>
<tr>
<td>2461 - 3160</td>
<td>High</td>
<td>Field crops mostly unaffected.</td>
</tr>
<tr>
<td>3161+</td>
<td>Very High</td>
<td>Field crops mostly unaffected.</td>
</tr>
</tbody>
</table>

³ ppm = parts per million total salt in the air-dried sample

Organic Matter

Organic matter is estimated from total carbon determined by Carlo Erba (combustion).

Details of your soil test report

Water pH: Actual soil pH ("Water" refers to the method of measuring pH). Most plants grow best at a slightly acidic range of 6.1 to 6.5 when nutrients are most available.

Buffer Value: An additional procedure we do where lime might be required. It helps to formulate a lime rate of application based on the buffering capacity of your soil.

Nutrient Results - Site equations above. Nitrogen/Phosphorus/Potassium - Where fertilizer recommendations are given in actual pounds of nutrient per acre expressed as N-P-K. Those crops grown in smaller areas will be provided recommendations in square footage noted in text below lime recommendations.

Limestone - If lime is recommended, water pH is too low for optimal plant growth. Compost and soil varies with both crop and soil.

For plants with the recommended target pH range of 6.1 to 6.5, at pH 6.0 - 5.8, chances are low for a response to lime. At pH 5.6 - 5.7, chances are medium for a response to lime. At pH < 5.6, chances become high for a response to lime. At pH ≤ 5.5, chances become very high for a response to lime. You may receive any lime at the time of the year, however, fall applications are best. Types of lime recommended are ground agricultural limestone or pelleted lime.

Text Note: Contains crucial information concerning fertilizer recommendations and specific instructions on types, rate of application, and dates when applications should be applied.

Reference: Programs in agriculture and natural resources, arts, youth development, family and consumer sciences, and resource development, University of Tennessee Institute of Agriculture, U.S. Department of Agriculture and county governments cooperating. UT Extension provides equal opportunities in programs and employment.
Indicator Plants

Species
• Knotweed
• Rushes
• Goosegrass
• Bitter sneezeweed
• Dog fennel
• Buttercup
• Curly dock

Predicted
• Compaction
Indicator Plants

**Species**
- Horse nettle
- Bitter sneezeweed
- Spiny amaranth
- Goosegrass
- Bermudagrass
- Buttercup
- Crabgrass

**Predicted**
- Overgrazing
Indicator Plants

Species
• Rabbit tobacco
• Red sorrel
• Poor joe
• Broomsedge
• Sweet vernal grass
• Oxeye daisy
• Yarrow

Predicted
• Low fertility soil
Grazing Management Rules of Thumb

• Forage stands with plants 6” or closer together can be improved with management

• ***Respect minimum grazing heights and recovery times
  • Exceptions releasing another forage in the seedbank or overseeding a field
  • Sacrifice area can be up to 20% of total pasture acreage

• Plant recovery time

• Take half leave half

• Top Third grazing

• Adaptive Grazing

• Keep light to desired plant community (key plants)

• Does a field need disturbance or recovery

• Sacrifice area, hay, mineral, mobile shade on weedy or low fertility areas

• Set grazing height by rotating off at desired ht
Orchardgrass Cutting Height Study by the University of Kentucky
Ray Smith and Associates

- 4 year old field of Benchmark Plus
- 3 Cutting Heights
  - 4 inches
  - 2 inches
  - ½ inches
- 4 Fertilizer Rates (3 applications)
  - 0 N and 0 K
  - 60 N and 0 K
  - 0 N and 100 K
  - 60 N and 100 K
Figure 2. Weed percentage after fourth harvest.

(LSD (0.05) = 13%)

[ON - 0K, ON - 100K, 60N - 0K, 60N - 100K]
Figure 4. Stand persistence after fifth harvest.

LSD (0.05) = 8%

- ON - 0K
- ON - 100K
- 60N - 0K
- 60N - 100K

Percent Persistence vs Cutting Height

Cutting Height (m)
Day 1
(24 hours after clipping)
1” Continuous  3.5” Rotational
Day 2

1” Continuous    3.5” Rotational
Day 3

1” Continuous  3.5” Rotational
Day 4

1” Continuous  3.5” Rotational
Day 5

1” Continuous  3.5” Rotational
Day 6

1” Continuous  3.5” Rotational
Effect of post-grazing residual on pasture daily growth rate ($MU$-$FSRC$)

It takes grass to grow grass!

- Time to grow 1 ton = 64 days
- Time to grow 1 ton = 40 days

Pounds of Growth per Day

30 vs 50

Daily growth rate (lb/acre/day)

Residual height (inches)

0 2 4 6 8

0 20 40 60 80

$\text{It takes grass to grow grass!}$
Starting and Stopping Grazing

<table>
<thead>
<tr>
<th>Species</th>
<th>Start</th>
<th>Stop</th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>10-16</td>
<td>2-4</td>
<td>30-40</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td>4-8</td>
<td>1-2</td>
<td>7-15</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>4-8</td>
<td>2-3</td>
<td>15-30</td>
</tr>
<tr>
<td>Ky. Bluegrass</td>
<td>8-10</td>
<td>1-3</td>
<td>7-15</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>8-12</td>
<td>3-6</td>
<td>15-30</td>
</tr>
<tr>
<td>Switchgrass</td>
<td>18-22</td>
<td>8-12</td>
<td>30-45</td>
</tr>
<tr>
<td>Pearl Millet</td>
<td>20-24</td>
<td>8-12</td>
<td>10-20</td>
</tr>
</tbody>
</table>
**Why Soil Health Matters**

- Infiltration Instead of Runoff
- More Forage Production
- Healthier Plants/Less Weeds/Fewer Inputs
- Healthier Diet for Livestock

**Adaptive Grazing for Soil Health:**

- **Supporting a Habitat for Diversity**
- Less Disturbance
- More Diversity
- Living Roots
- Continuous Cover
Healthy Soil creates its own Aggregate Stability ("Chocolate Cottage Cheese")

Numerous organisms, from bacteria to earthworms, along with living roots, put out sticky “exudates” that hold soil structure together, forming pore space so that water and air/nitrogen can infiltrate and become available to plants.
Healthy soil supports water-stable aggregates formed by soil life: water and air move easily through intact pore space.

Too-often-disturbed soil is lifeless and weak and harbors unstable aggregates that fall apart; critical pore space is broken and filled; water and air cannot infiltrate.

Ray Archuletta’s “Slake Test”
Healthy Soil Supports More Forage Production:

Plants offer root exudates (that contain carbohydrates and amino acids) to soil microbiota in exchange for water and nutrients.

Therefore, healthier soils with more living roots and microbiota are able to grow more forage.
Managing Appropriate Disturbance

Fire
Compaction
Mowing
Grazing/Soiling/Trampling
Chemical Inputs
Nutrient Application

Adaptive Grazing is focused on using disturbance as a TOOL: controlling the time and space your animals “disturb” the pasture by eating, defecating, and trampling it, as well as your mowing, feeding, and fertilizing practices.

Clipping height should leave enough leaf area for fast regrowth (3” to 8”)

Grazing corn with too much residue removed, leave 90% ground cover

Portable fence allows you to manage cover and disturbance
Managing Disturbance

Giving pastures enough recovery time roots slough and regenerate improving aggregate stability

Dr. Dennis Hancock, UGA
The classic table of leaf defoliation and root growth stoppage

<table>
<thead>
<tr>
<th>Percent leaf removal</th>
<th>Root growth stoppage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>70</td>
<td>78</td>
</tr>
<tr>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>90</td>
<td>100</td>
</tr>
</tbody>
</table>
Leaf Area Needed Prior to Grazing

- **Grasses**: 7 to 11 leaves/unit area
- **Broadleaves** like clover: 3 to 5 leaves/unit area
- **Alfalfa**: 5 to 6 leaves/unit area
- Stick a pin in the ground and it should intercept this many leaves.
When to graze a field?

- When it is 8” tall with 7 or more leaf area index
- Boot stage
- When brown leaves are shading green leaves
- Look down, Look ahead and Look behind
- Warm season growth can be stockpiled into early winter.
- When a field needs fertilizing, feeding hay on a field will reduce incidence of overgrazing and increase fertility and add residue
The Three Phases of Growth and Yield
- Quality Compromise

Phase 1: Less rest
Phase 2: More rest
Phase 3: More rest

Quality

Yield
Managing Disturbance

Controlled Mowing or Grazing/Soiling/Trampling/Compaction:

LOW UTILIZATION can result from understocking; these pastures need disturbance.

Spot grazing leaves stools of grass behind. Needs mowing or hard grazing to make vegetative again.

BROWN (old warm season plants) shading GREEN (new cool season plants). Needs mowing or hard grazing to release new growth from underneath canopy’s shade.
Managing Disturbance

Adapt your grazing plan to promote healthy soil; first assess what a particular pasture needs at this moment in time: Disturbance or Recovery

Hayed too many years, nutrients removed, resulting in a chemical imbalance: this NEEDS DISTURBANCE (grazing, hoof action, clipping or burning, manuring) and then LONG RECOVERY.

Wasted Forage? or Banking Carbon!
A healthy pasture RESTING for even better production in future?

Needs long recovery/rest
Managing Disturbance
Chemical Inputs/Nutrient Application

80% of nutrients livestock consume is returned to the soil in manure.

Buttercups are tough to handle. Sometimes herbicide or tillage is required, but often, raising grazing height will allow desirables to outcompete it.

Feeding Unrolled Hay

Lines of greater fertility where HAY WAS UNROLLED the year before
Managing Disturbance
A Case Study:
Controlling weeds without chemicals

MAY: 12 ft tall poison hemlock and thistle:

By mowing at the CORRECT TIME, weeds were successfully controlled without outside inputs.

September: solid fescue, without spray.
Why Manage for More Diversity?

Different plants have
• different structures
• different root exudates
• different seasons of growth

Roots fill voids both in space and time, creating HABITAT for a diversity of organisms living in the soil, from bacteria to earthworms.

Sally Holt, 1999
From plant diversity comes a *diversity* of soil organisms.
These organisms live:

- Around roots
- In litter
- In spaces between aggregates
- In humus
Forage Diversity

• Diverse forages can be in the same paddock or separate paddocks
• Spreads out the growing season and allows you to stockpile forage in more seasons for an extended time.
• Legume Nitrogen
• Grass- biomass (e.g. corn for grazing)
• Brassicas and chicory- just grazing and soil health not hay
• Cool season forages
• Warm season forages (Natives particularly adapted to low production soils)
• Annuals and perennials
Managing for More Diversity

- Delaying grazing so desired plants have time to establish and grow, or
- seeding diverse mixes of grasses, legumes, brassicas, and other forbs
Managing for More Diversity
Controlled/focused grazing or seeding on specific problem areas for weed control

Austrian winter peas and Hairy vetch were left ungrazed and allowed to smother buttercups.

High Density and/or Multispecies grazing turns “weeds” into forage.

These plants can help control weeds:
- Winter Rye
- Annual Ryegrass
- Black Oats
- Brassicas
- Sorghums

Ryegrass “mulch” (on left) kept down pigweed.

Photo by Kathy Voth
Managing for Continuous Cover

Naked and exposed to the elements, this soil is dehydrated, running a fever, prone to erosion and death in a drought and invasion by weeds.
When Soil Temperature Reaches (F degrees):

- 140  Soil bacteria die, soil sterilization
- 130  100% of soil moisture is lost through evapo-transpiration
- 100  15% of moisture is used for growth
- 85% of moisture is lost
- 70  100% of soil moisture is used for growth
Unrolling hay offers a layer of mulch: here, February grass is three times taller where moisture was conserved and soil warmed in winter.
Managing for Continuous Cover

Green residual growth and brown residue moderate soil temperature and conserve moisture, providing food and habitat for soil life.

*Earthworm castings are 5 times more fertile than surrounding soil.*
Managing for Continuous Cover

Typically manage forage that you have, but when needed plant a diverse forage mix that will provide cover throughout the year.

Wasted Forage?
Or instead, a long recovery that will create a healthy layer of mulch and nutrients for soil microbiota when this grass is laid down on the soil?

Initiating soil health low C:N ratio covers are important as the soil becomes healthier and supports more life higher C:N ratio cover is need to feed the soil life.
Environmental Concerns for Beef Cattle Producers
POTENTIAL WATER-BORN DISEASES

- Coccidiosis
- Leptospirosis
- Foot rot
- Anthrax
- Brucellosis
- Erysipolis
- Other disorders result from blue-green algae, E-coli, Salmonella etc
Radial Design, 8 Fields with 1 Water Point
Two Water Points 5 Fields
8 PADDOCK/ 1 WATER POINT

Permanent fence

Permanent fence
(optional)

Permanent fence

Water point
<table>
<thead>
<tr>
<th></th>
<th>Permanent fence</th>
<th>Water point</th>
<th>Permanent fence</th>
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<tr>
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<td>(optional)</td>
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<tr>
<td>Permanent fence</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
BACK GRAZE FOR 3 DAYS
High performance per animal and per acre

Figure 2. Effects of increasing stocking rate on pounds of production/animal and production/area of land (from Conner 1991).

Prod/AU = Production/Animal Unit (1,000 cow)
Prod./ha = Production/hectare or production/acre
STOCK/ha = Stocking rate per hectare or acre
16 PADDOCK with 4 WATERING POINTS
(funneling animals)
Gate Arrangements

16' gates
90 degree
= 22.5' gate openings

No post in center
To layout stake with string in center where gates swing together
2 Gates Four fields if rotational grazed, bungy gates can be different widths
Balance fertility
Take Half leave half (manage grazing hts)
Consider top third grazing
Continue to feed hay till grass is 8” tall (7 or more leaves)
Utilization is good but litter (residue) is needed for soil health
Eight paddocks minimum per herd (16 to 45+ best)
Temporary wire is useful tool between permanent parallel fences
Don’t drive all over your fields, compaction is an issue
Don’t worry about vegetation getting away from you it is not waste it is feed for your other cows “the micro-cows”
Annual Pasture Walk - October 19, 2017
Big Springs Farm, Adolphus, KY
Comments/Questions/Ruminations?
greg.brann@tn.usda.gov
Welcome friends on Facebook.