Assessing the Pasture Soil Resource

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By Preston Sullivan
NCAT Agriculture Specialist
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By Hannah Sharp
NCAT Intern

Contents

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This technical note provides methods to determine biological activity of pasture soils and practical tips on improving the usefulness of typical soil and plant samples. The soil biology sampling methods are easy to learn and utilize commonly available tools found around any farm. Once these biological assessments are made, more insight into the many benefits of nutrient cycling becomes apparent. Methods for strategically using soil and plant samples are also covered.

Introduction

Making fertility assessments

A typical soil analysis will provide a guide to the current plant nutrient levels in a pasture soil. For an analysis to be accurate, good sampling procedure must be followed. Before sampling a pasture soil:

1. Visit the county Cooperative Extension Office and get their guide on soil sampling procedure.
2. Look across the landscape and locate all hotspots. Hotspots are areas of excessive or unusual nutrient concentration, such as soils around feed bunks, hay feeding areas, shade trees, watering sites, loafing areas and wet spots.
3. Sample these hotspots separately, or avoid them during your sampling.
4. Sample according to apparent patterns such as slope and previous fertilization. When field areas appear dissimilar, sample them separately. Nutrients tend to flow downhill in pastures, meaning that top slopes will tend to have lower nutrient levels and the down slope will tend to have higher levels. Mixing soil samples from all over the pasture will mask these differences and lead to wasted fertilizer dollars. When it comes time to buy fertilizer, you may only need to fertilize the ridge tops and will be glad you sampled top, side and end slopes separately.
5. Make sure that sampling depth matches the depth that the soil test report will be based on. Many agronomists advise taking pasture samples at 3 or 4 inches deep because most of the grass roots are in the top 4 inches. The prescribed depth should be in the soil sampling procedure from your Cooperative Extension Office. If you do take a sample at a depth other than the one the lab specifies, make note of it on your sample sheet so the lab can adjust accordingly.
6. Prepare the sample for shipping according to the lab's recommendations.

Photo by Susan Tallman, NCAT.

Producers generally have the choice of using a private laboratory or the state university lab to do their soil analysis. Commercial labs cost more but generally have a quicker turnaround time and a more complete soil test report than university labs. Though hotly contested by some researchers, soil analysis featuring the base saturation percentages

provides useful information for making fertilizer choices. If you would like to get a second opinion, it may be worthwhile to hire a consultant to help you with the sampling and the fertilizer recommendations.

To back up your fertilization program you may want to take forage samples to see what effect the fertilizer had. You can also strategically utilize soil and forage tissue sampling by making comparisons between poor growth areas and good growth areas, or before-and-after comparisons. The three tables below show some hypothetical examples of strategic soil and plant tissue sampling.

Forage analysis can be used to judge the success of a fertilization program by identifying any remaining nutrient deficits. For example, the before-and-after forage analysis shown in **Table 1** shows that the applied fertilizer met all crop needs for major and secondary nutrients. In addition, soil and forage analysis taken from adjacent poor and productive field areas can be used to better identify nutrient imbalances. This is illustrated in **Tables 2** and **3.** Visit your county extension agent or a private consultant to learn effective methods for taking a forage sample.

Related ATTRA publications

Nutrient Cycling in Pastures

A Brief Overview of Nutrient Cycling in Pastures

Sustainable Soil Management

Table 1. Forage tissue analysis before and after fertilization

Nutrient	Before fert.	After fert.
Nitrogen	low	OK
Phosphorus	OK	OK
Potassium	low	OK
Calcium	OK	OK
Magnesium	OK	OK
Sulfur	low	OK

Table 2. Forage tissue analysis between a poor area and a good area

Nutrient	Poor area	Good area
Nitrogen	low	OK
Phosphorus	OK	OK
Potassium	low	OK
Calcium	OK	OK
Magnesium	OK	OK
Sulfur	low	OK

Table 3. Soil test analysis between a poor area and good area of a pasture

Nutrient	Poor area	Good area
Nitrogen	—	—
Phosphorus	OK	OK
Potassium	low	OK
Calcium	OK	OK
Magnesium	OK	OK
Sulfur	OK	OK

Assessing soil biological activity and health

While nutrient status is essential to soil health and vitality, biological activity and soil structure should be appraised to get a more complete picture. The biological soil component creates and maintains many desirable soil conditions. Many biological parameters are quite costly to measure and require hours of laboratory time. Others can be quite inexpensive and convenient. The following assessment procedures can be performed in an hour or so using inexpensive, locally available materials (Holistic Management International, 2007). These procedures are derived from *Holistic Management Biological Monitoring Manual* available from Holistic Management International. For a more complete cropland assessment, order this publication. Ordering information is listed in the **Further resources** section.

When to make these assessments

Choose a time of year when soil biological activity is high, usually in late spring and mid-fall. Select a day when the soil is moist but not wet, after all excess water has drained away. Generally, the soil is right for this assessment when you cannot roll the soil into a ball and it crumbles easily in your hand.

Avoid taking samples:

- From wet soils. When the soil sticks to your shoes, it is too wet.
- During drought periods or times of excessive heat.

- From cold soils.
- Within a month following tillage, fertilization or liming.

Equipment needed

- Pencil
- Assessment sheet
- Clipboard to hold the paper
- Shovel
- Can or jar capable of holding 16 fluid ounces (1 pint) but no more
- Small round bottle capable of holding ½ cup of water
- Bucket with 2 gallons of water for each assessment sheet to be filled out
- Watch with a second hand or a stopwatch
- Tape measure
- Hand grass clippers
- Homemade soil penetrometer, described below
- A wire ring that measures 1 foot across, made of wire or flexible pipe

  Note: The length of wire required to make a circle with a 1-foot diameter is approximately 39 inches, depending on the thickness of the wire. Remember to allow some extra length to attach the two ends and make the ring. Measure the diameter of the wire ring when the ends are attached to make sure it is 1 foot across.

Locating sample sites

An individual assessment sheet should be used for each pasture. If a pasture is highly variable, assess each distinct area separately. In each pasture unit, three sampling sites should be selected. Use field maps, compasses, landmarks or global positioning systems to locate representative sample sites that can be relocated year after year. These sites become permanent locations for assessing change over time. Each field site can be marked on a map to aid relocation. At each sampling site, choose two points to take the actual assessment.

Begin by selecting the first point for evaluation at the sampling site and lay the 1-foot diameter ring on the ground. The following assessments are most conveniently done by completing all six at the first point before moving on to the second point.

Points of assessment

1) Living organisms

Clip all the standing vegetation within the wire circle down to the ground and remove it. Pull back the soil surface litter and look for signs of living organisms other than plants. A small hand rake may help in turning the surface litter. Count the number of different kinds of living critters, such as beetles, ants, millipedes, centipedes, snails and more, on the soil surface within the ring. Record the numbers on the assessment sheet.

If a pasture is highly variable, assess each distinct area separately. In each pasture unit, three sampling sites should be selected.

It is advisable to start turning the surface litter from the outside of the ring toward the center. This forces mobile critters to the center where they will be seen by the observer. If you start at the center and work toward the ring, the critters have a chance to escape outside the ring undetected. With this assessment the number of species, or diversity, is more important than the number of individuals.

A higher number of different types of organisms indicates more biodiversity. The more biodiversity, the better the first stage of decomposition will proceed.

2) Earthworms

While still at the circle, count the number of wormholes inside the ring. The surface holes are the vertical burrows of nightcrawler worms. After counting the wormholes, insert the shovel to its maximum depth and turn over the shovelful of soil. Break the soil apart with your hands and count the number of earthworms present. The smaller worms found with the shovel will most likely be the surface-dweller earthworms that do not burrow vertically.

Record the numbers on the assessment sheet. Also note how easy or difficult it was to shovel the soil. Turning a shovelful of

soil also correlates well with tilth and ease of tillage. The more earthworms found in this process, the better. Earthworm burrows enhance water infiltration and soil aeration. Earthworm digestion of soil and organic matter cycles nutrients. Worms are a general indicator of soil health. Earthworms may not be present in croplands recently converted to pasture. They should slowly return over several years from adjacent field margins as soil health improves.

3) Soil smell

While still at the hole dug for worm counts, grab a handful of topsoil and take a whiff. Record the smell on the assessment sheet as follows:

0.0 = putrid/chemical/sour

0.2 = no smell

0.4 = fresh/earthy/sweet

A well-aggregated soil will take in water rapidly, as will a soil with high numbers of vertical wormholes.

4) Aggregation

Select a soil aggregate, or crumb, from a handful of topsoil. Make sure the aggregate is not a rock or pebble. Put the aggregate in the small round bottle of water or the 1-pint container. Allow it to stand for one minute, using the stopwatch to keep time. Observe if the aggregate is breaking apart or staying intact. If it stays intact after one minute, gently swirl the bottle several times and observe again. If it is still intact, swirl the bottle vigorously and observe the aggregate again for intactness. Record the following scores:

1 = aggregate broke apart within one minute in standing water

2 = aggregate remained intact in standing water but broke apart after gentle swirling

3 = aggregate remained intact after gentle swirling

4 = aggregate remained intact after vigorous swirling

After vigorous swirling, remove the aggregate and smash it between your fingers to make sure it was not a pebble. If it was a pebble, select another aggregate and do the test again. Healthy soils have very stable aggregates, indicated here by a high score. Unstable aggregates break apart easily and the individual soil particles can be easily eroded by runoff water. Higher scores are generally more common under perennial sod. Lower scores are generally more common on soils with annual tillage operations and clean cultivation.

Move away from the wire circle to a fresh area. Clip a small area of grass to ground level if necessary to see the soil surface clearly. Fill a 1-pint container with water. Holding the container as close to the soil surface as possible, gently pour the water on the soil. Try to pour all the water out within five seconds, the idea being to avoid disrupting the soil surface with the water flow, but pouring fast enough to determine how quickly the water soaks into the ground. Using the stopwatch, start timing once all the water has been poured out. Stop timing when the last of the water just finishes soaking into the ground. This is the infiltration time to be recorded on the assessment sheet.

Next, measure the wet spot across its widest point with the tape measure and record the length on the assessment sheet. Pouring on a slope will influence the rate of runoff. If you are comparing two cropping practices on sloping ground, make sure the slope is the same under both practices since slope will influence the runoff rate.

5) Water infiltration

The faster water enters the soil, the less likely it is to run off overland and cause erosion. A well-aggregated soil will take in water rapidly, as will a soil with high numbers of vertical wormholes. Texture plays a significant role in water infiltration. Sandy soils will take in water more quickly than silty-loam soils, and clay soils will take in water quite slowly. Finally, since soil moisture at the time will influence this assessment, don't put too much confidence in an infiltration comparison between two fields if one is irrigated and the other is dry.

6) Soil compaction

Assessing soil compaction requires making a simple tool beforehand. A soil penetrometer

can be constructed from a 1/4-inch rod sharpened on the end as seen in **Figure 1** below. Start with a rod that is 3 feet long. Use a file to make 1-inch marks from the pointed end, as shown in the drawing.

Push your homemade penetrometer into the soil as deep as you can with modest effort. Record the inches of penetration up to a maximum of 12 inches. Do not record any penetration depths beyond 12 inches, as we are not testing for deep penetration. Avoid putting all your weight into the pushing or stomping on the penetrometer to make it go deeper. Record the penetrometer depth on the assessment sheet. If you hit a rock or tree root, try again. For comparison, probe an undisturbed natural area nearby with your penetrometer. As a secondary test, you may wish to probe deeper with a longer penetrometer to locate any deeper hard pans to note on the comment section of the assessment sheet.

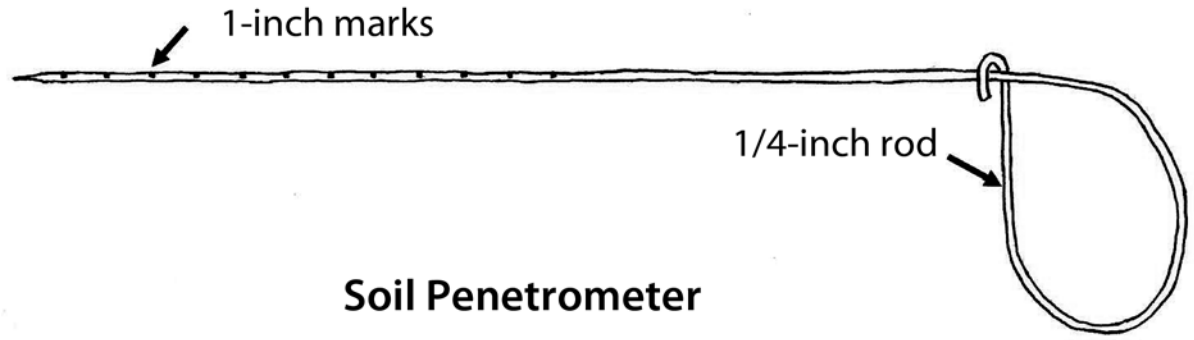
The deeper the probe easily penetrates the soil, the better. Ease of soil penetration with the penetrometer correlates to deep root development, ease of downward water flow, or no hardpan, and tillage ease. A probe that won't penetrate the soil indicates compaction of the surface layer, which restricts downward water movement (Holistic Management International, 2007).

Conclusion

Performing the soil organism assessment described will enhance observational skills, which is always beneficial. Some other useful observations include plant vigor, plant coloration, drought tolerance and the rate at which livestock manure is dispersed and decayed. Healthy soil conditions are largely created by the helpful soil organisms, which are beneficial with a little management to meet their needs.

Don't be discouraged if the pasture assessment numbers come up lower than expected the first time. Rather, let the results be an incentive for continued commitment to soil improvement. Pursue progress rather than perfection. An assessment provides a starting point from which to build toward the future. Set your sights high. Discard the idea that soils require hundreds of years to build up. Soils can begin to improve just a few months after appropriate decisions are made.

Figure 1: Homemade soil penetrometer



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To order this publication, visit the Stockman Grass Farmer online store at www.stockmangrassfarmer.net/cgi-bin/page.cgi?id=364.html *or contact Stockman Grass Farmer, PO Box 2300, Ridgeland, MS 39158-9911, 1-800-748-9808, (601) 853-1861, (601) 853-8087 FAX,* sgf@stockmangrassfarmer.com

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To order this publication, visit the Soil and Water Conservation Society online store at http://store.swcs.org/index.cfm?fuseaction=c_Products.viewProduct&catID=574&productID=5154

Holistic Management International. Holistic Management Biological Monitoring Manual. 2007. 59 p.

To order this publication, visit the HMI online store at http://holisticmanagement.org/store//page4.html *or contact Holistic Management International (HMI), 1010 Tijeras, NW, Albuquerque, NM 87102, (505) 842-5252, (505) 843-7900 FAX,* hmi@holisticmanagement.org

Pasture Soil Assessment Sheet

Property_____ **Field** _____ **Date** _____ **Examiner** _____

Points	Living organism types	Earthworm holes	Earth-worms	Soil smell	Aggrega-tion	Water infiltration	Water infiltration	Soil penetra-tion
	species/ circle	#/circle	#/shovel	score[a]	score[b]	time[c]	distance[d]	inches
Site I	1							
	2							
Site II	1							
	2							
Site III	1							
	2							
Totals								
Average*								

[a] smell score = 0 putrid/chemical/sour; 2 no smell; 4 fresh/earthy/sweet; for in-between smell, use odd numbers 1 or 3.

[b] aggregation score – 1 = broke apart in water after 1 minute; 2 = broke apart after gentle swirling; 3 = intact after gentle swirling; 4 = intact after vigorous swirling

[c] time required for water to infiltrate into the soil

[d] distance across wet spot at widest point

[*] divide the total in each column by 6

Supporting Information

1. Are there signs of erosion in this field? yes _____ no_____

2. List the crops and practices done in this field in the last 2 years: _____

_____

_____

_____

_____

Comments:

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Holly Michels, Editor
Amy Smith, Production

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