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Nematode-Based Soil Health Scoring Guide

A Practical Diagnostic Tool for Growers and Master Gardeners

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Introduction

Soil health is the foundation of productive agriculture and resilient gardens. While standard soil tests measure chemical properties such as nutrients and pH, nematode analysis provides a direct window into soil biology. Because nematodes occupy multiple trophic levels and respond predictably to environmental conditions, they serve as reliable bioindicators of soil health, disturbance, and biological balance. Healthy soil contains a diverse and balanced nematode community.

What Are Nematodes?

Nematodes are microscopic roundworms found in all soils. Most are beneficial and contribute to nutrient cycling, decomposition, and regulation of microbial populations. A smaller group feeds on plant roots and can reduce plant growth and yield.

Why Nematodes?

Nematodes are valuable indicators of soil ecosystems because they are ubiquitous, abundant, and easily extracted, allowing consistent measurement across systems. Their mouthparts reflect feeding function, enabling classification into functional guilds that reveal soil food web structure. They occupy multiple trophic levels and are themselves prey, linking energy flow through the system. Nematode populations respond predictably to the soil's physical and chemical environment, and their resilience and persistence under stress make them reliable indicators of soil condition and change.

Why Not Other Organisms?

Bacteria and fungi are highly diverse and essential components of soil ecosystems; however, their immense diversity and rapid population turnover make them more difficult to quantify consistently in routine diagnostic settings. In contrast, nematodes provide a stable, integrative signal of soil biological condition that can be measured and interpreted more reliably over time.

What are the Five Nematode Functional Groups?

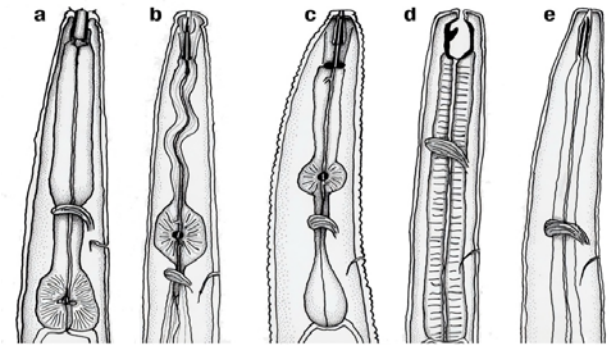

Figure 1. a. Bacterivores – bacteria feeding nematodes, b. Fungivores – fungus feeding nematodes, c. plant-parasites – feed on roots, d. predators – feed on nematodes, and e. omnivores – feed across multiple trophic levels, including plants, fungi, and animals

How Do I Make a Community Analysis?

1. Sample in late summer
2. Take 20-30 sub-cores 6-8 inches deep within the root zone
3. Combine into one composite sample
4. Place it into a pint-sized plastic bag
5. Keep the sample cool (not frozen)
6. Mail to the Lab within 24-48 hr.
7. Label with details for communication.
8. Include payment as required (available upon request)
9. Payable to "Treasurer, Virginia Tech"
10. Mail to: Virginia Tech Nematode Assay Lab
11. 115 Price Hall, Virginia Tech
12. Blacksburg, VA 24061
13. For questions, contact VT Nematode Assay Lab

What Should Your Nematode Test Include?

Interpretation

Category	Condition	Score
Beneficial nematodes	High levels	20 - 25
	Moderate levels	10 - 19
	Low levels	0 - 9
Predators	Abundant levels	20 - 25
	Moderate levels	10 - 19
	Low levels	0 - 9
Plant parasites	High levels	0 - 9
	Moderate levels	10 - 19
	Low levels	20 - 25
Balance ratio*	> 10:1	18 - 20
	3 - 10:1	10 - 17
	<3:1	0 - 9

*Balance ratio = (Beneficial nematodes ÷ Plant-parasitic nematodes)

What Does My Score Mean?

Excellent (85–100) - Diverse and balanced soil food web, strong nutrient cycling, and natural pest suppression
Management: Maintain current practices; avoid excessive disturbance
Good (70–84) - Functional system with minor imbalance
Management: Add organic matter and monitor nematodes
Moderate (50–69) - Reduced diversity and early imbalance
Management: Use cover crops, increase organic inputs, and improve crop rotation
Poor (30–49) - High plant-parasitic pressure and weak biological structure
Management: Rotate crops, use resistant varieties, and apply compost or organic amendments
Very Poor (<30) - Severely degraded soil system
Management: Integrated approach, organic matter, additions, crop rotations, biological inputs, and targeted nematicides

Soil Health Scoring System (0-100)

Scores from each category are summed to generate a total soil health score (0–100). This scoring system emphasizes biological balance, with higher scores reflecting diverse, structured, and functionally active soil food webs.

Soil Health Scoring System

Score	Soil Health
85 -100	Excellent
70 - 84	Good
50 - 69	Moderate
30 - 49	Poor
< 30	Very Poor

What is a Healthy Soil?

In healthy soil systems, free-living nematodes dominate the community, reflecting active microbial processes and balanced trophic interactions. Plant-parasitic nematodes are typically present at low levels, indicating minimal pest pressure and effective ecological regulation. The nematode assemblage is diverse, encompassing multiple functional guilds that contribute to nutrient cycling and energy flow. Notably, higher trophic groups such as omnivores and predators are well represented, signaling a structured and stable soil food web.

Quick Field Checklist

Ask these three diagnostic questions:

1. Do I have a diversity of functional groups?
2. Are predators and omnivores present?

3. Are plant parasites dominating the sample?

When Should I Test My Soil?

Best Timing for Nematode Sampling

- Late summer to early fall (peak populations)
- During crop decline or poor growth
- Before planting a new crop
- After management changes (cover-crops, amendments)

What is the Key Take-Home Message?

Healthy soil contains a diverse nematode community dominated by beneficial groups, with plant-parasitic nematodes present at low levels.

How can I Restore or Maintain Healthy Soil in My Garden?

One practical approach to improving soil health is sheet mulching, particularly in garden and small-scale systems. Sheet mulching is a no-till method that uses layered organic materials to improve soil structure, increase organic matter, and enhance biological activity while suppressing weeds.

What are the Benefits of Sheet Mulching?

Sheet mulching eliminates the need for tillage and converts poor soil into productive garden beds (Figure 2). It restores the food web by encouraging beneficial bacteria and fungi and stimulating earthworm activity. This method improves water retention and provides excellent weed control.

What Materials are Needed?

A base layer of plain cardboard (remove tape, staples, and glossy coatings), and organic layers of compost, grass clippings, leaves, or straw or hay, aged manure, or wood chips make up the layered sheet for gardening.

What is the Step-by-Step Procedure?

1. Site Preparation

- Mow or cut existing vegetation low
- Leave roots in place (no tilling)

2. Lay Cardboard

- Cover the entire area
- Overlap edges by 2–4 inches
- Avoid gaps (prevents weed breakthrough)

3. Wet Thoroughly

- Soak the cardboard completely
- Helps it conform to the soil and begin decomposition

4. Add Nutrient Layer

- Apply 1–3 inches of compost or manure

5. Add Organic Matter

- Layer leaves, grass clippings, or other materials

6. Apply Mulch Layer

- Top with straw, hay, or wood chips (2–4 inches)

7. Water Again

- Ensure all layers are moist

8. Planting Options

- Immediate Planting
  Cut holes in cardboard
  Plant directly into the compost layer
- Delayed Planting
  Wait 3–6 months for decomposition
  Plant into improved soil

Figure 2. Sheet mulching process. Steps include mowing and watering, applying cardboard to suppress weeds, adding compost, and topping with mulch (Image created with GROK AI)

What are Some Common Mistakes to Avoid?

- ❌ Using glossy or coated cardboard
- ❌ Leaving gaps between sheets
- ❌ Not wetting layers thoroughly
- ❌ Using too little organic material
- ❌ Applying too thin a mulch layer

What are Some Potential Issues?

Slugs and snails may increase in moist environments, and in cold or dry conditions, the breakdown of the organic materials may be slow.

What are the Best Use Situations?

This method is best for converting turfgrass to garden beds, establishing raised or in-ground garden beds, improving compacted or low-organic soils, and developing an organic and sustainable production system.

How can I Receive Assistance?

Contact the Virginia Tech Nematode Assay Lab or your local Virginia Cooperative Extension office for sampling and interpretation support.

Disclaimer

This guide provides general recommendations. Management decisions should consider crop, location, and environmental conditions.

Links

Soil Health (https://www.nrcs.usda.gov/soil-health)
Soil Food Web (https://soilfoodweb.com)
Sampling Guidance (https://ext.vt.edu/agriculture/soil-testing.html)
IPM and Soil Biology (https://www.ars.usda.gov/services/grants/scbgp)

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