Root Health Assessment Checklist for Producers

Introduction

This guide is designed to assist producers in the field with assessing root health, the rhizosphere, and legume nodulation. It provides key observations and evaluation techniques to help monitor soil and plant health.

Considerations

- Timing: Examine roots when plants are at their peak, just before flowering, to observe the most robust root growth.
- Soil Condition: Conduct the examination when the soil is moist to make root extraction easier.
- Root Type: Determine whether the plant has a tap root or fibrous roots, and consider where these roots are most likely located within the soil profile.

Steps for Root Health Assessment

Digging and Excavation:

- Use a shovel to dig deep enough to extract a sizable section of the root system.

Examine Roots:

- Assess root abundance, branching, and depth.
- Take note of:
  - The width of the tap root.
  - The number of roots extending below the excavation point.
  - Any horizontal growth or sharp angles, which may indicate potential soil barriers or compaction.

Record Observations

Use the root observation checklist to assess root health:

- Poor: Roots are restricted, sparse, or lack abundant growth.
- Fair: Roots are somewhat restricted, with some fine roots visible, but growth is moderate.
- Good: Roots are abundant, well-branched, and appear unrestricted, indicating healthy growth.

Poor

Fair

Good

Rhizosphere Health Assessment Guide

What Is the Rhizosphere?

The rhizosphere is the area of soil surrounding plant roots, where plant roots and soil microbes interact. It plays a critical role in plant health and nutrient uptake. A key indicator of rhizosphere health is the presence of rhizosheaths, which is a layer of soil particles that cling to the roots, created by beneficial microbes.

Steps for Rhizosphere Health Assessment

1. Breaking away soil
    a. After excavating the roots, gently break away the soil around them.
    b. Lightly shake the roots to remove any loose soil from the root system.
2. Look for rhizosheaths
    a. Check if there is any soil adhering to the roots. This can indicate the presence of rhizosheaths.
    b. The presence of rhizosheaths indicates active microbial life and healthy soil-root interactions. Microbes make the glues that hold the sheaths together. No microbes = no glues = no sheaths.

Scoring Rhizosphere Health

Use the following scale to assess the health of the rhizosphere based on the presence and coverage of rhizosheaths on plant roots:

- Poor: no soil covering around the roots; roots are white, clean, and lacking rhizosheaths.
- Fair: some roots are coated with soil, either partially or fully; rhizosheaths are present but not abundant.
- Good: most or all roots are fully coated with soil, indicating healthy rhizosheaths.

Poor

Fair

Good

Rhizosphere Scale adapted from *Vidacycle (n.d.). Rhizosheaths. https://soils.vidacycle.com/soil-tests/1-4-rhizosheaths/*

Legume Nodulation Assessment Guide

Nitrogen Fixation in Legumes

Legumes have a unique ability to partner with nitrogen-fixing bacteria, which form nodules on the roots. These bacteria can fix nitrogen from the air, converting it into ammonia, a key nutrient for plant growth.

Steps for Legume Nodulation Assessment

1. Excavate the Roots
    a. Gently break or wash away soil surrounding the roots of the legumes to expose the root system.
2. Examine for Nodules
    a. Look for swollen, rounded lumps on the roots. These are the nodules where the nitrogen-fixing bacteria reside.
3. Cut and Inspect Nodules
    a. Cut open the largest nodules and observe the color inside.
    b. Red or pink color indicates active nitrogen fixation, meaning the bacteria are effectively converting nitrogen from the air into ammonia.

Scoring Nodulation Health

Use the following scale to assess the nodulation and nitrogen-fixing activity:

- Poor: no nodules or very few, small nodules located high on the roots.
- Fair: small nodules present high on the roots.
- Good: well-distributed, healthy nodules across the root profile, with pink or red coloration inside.

Poor

Fair

Good

Chaulagain, D., & Frugoli, J. (2021). The Regulation of Nodule Number in Legumes Is a Balance of Three Signal Transduction Pathways. International journal of molecular sciences, 22(3), 1117. https://doi.org/10.3390/ijms22031117