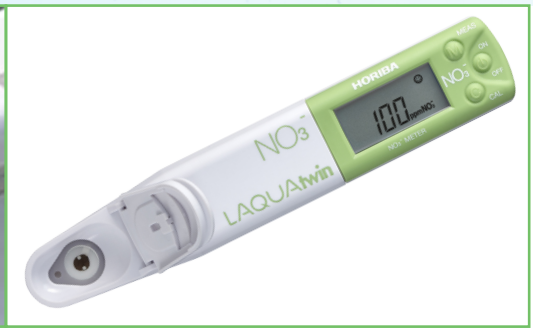
Soil Nitrate Measurement for Determination of Plant-Available Nitrogen

Application Note

Nitrate concentration in soil is a good indicator of available nitrogen to plants. The required soil nitrate-nitrogen (NO_3-N) for specific crops varies from crop to crop but in general, a concentration range of 10-50 mg/kg is desired.



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Introduction

Soil testing has been used effectively over the years in determining the availability of nutrients for plants. Nitrogen is one of these essential nutrients, which is converted to amino acids and then utilized in producing necessary enzymes and structural parts of the plant.

The LAQUA twin Nitrate Ion meter can be used to measure NO_3-N concentration in soil samples. It is an easy-to- use pocket-sized meter that provides quick results for on-site testing, thus eliminating the need to transport samples to a laboratory for colorimetric or chromatography analysis performed by trained analyst.

Method

Sample Collection And Preparation

1. Collect dry soil samples and pass through a 2mm sieve.
2. Prepare soil extract by mixing soil and water or extractant in 1:5 ratio (e.g., 5g soil and 25mL water or extractant). Shake for 1 minute. Allow the sample to settle for 5 minutes or filter it using filter paper and funnel.

Calibration

Calibrate the LAQUAtwin Nitrate Ion meter using two NO_3-N calibration standards according to manufacturer's instructions. Make sure that the meter measurement unit is set to ppm NO_3-N.

Sample Measurement

1. Place some drops of unused water or extractant into the sensor.
2. Record the reading as the blank. Blank is only required once for each batch of samples.
3. Rinse the sensor with water and blot it dry with tissue.
4. Place some drops of clear liquid taken from the top layer of soil extract (or filtrate, if filtered sample).
5. Record the reading once stabilized.
6. After each sample, rinse the sensor with water and blot it dry with tissue.

Collect dry soil samples and pass through a 2mm sieve.

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Results and Benefits

To express the results in NO_3-N mg/kg in soil, use the formula: NO_3-N mg/kg in soil = (soil extract reading - method blank) ppm NO_3-N × 5. If a different ratio is used in soil extract, substitute '5' with the appropriate ratio.

Nitrate-nitrogen (NO_3-N) measures the amount of available nitrogen in the soil that can be absorbed immediately by plants. The amount required in the soil for specific crops varies from crop to crop, but in general the levels should not fall below 10 mg/kg and should not exceed 50 mg/kg. However, nitrate varies with soil water and so levels can fluctuate widely depending on soil water movement.

Nitrate nitrogen (mg/kg)

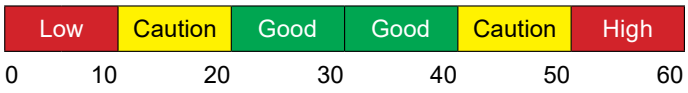

Figure 1: Guide to the interpretation of nitrate-nitrogen values for soils (Source: Soil health for vegetable production in Australia—Part 4)

To determine the amount of nitrogen fertilizer needed to meet crops' demand, the NO_3-N concentration is being subtracted from the nitrogen requirement of the crop.

Supplementary Information

- **Soil** – Wet samples will need to be air dried by spreading thin layer of soil in a sheet of plastic under the sun. This is to eliminate the effect of the soil's moisture content. Samples that have too much clay will need to be crushed.
- **Extractant** - Water or dilute salt solutions can be used to extract nitrate from most soils because essentially all the nitrate in soils with low anion exchange capacities is water soluble. The main disadvantage of water is its low ionic strength which can cause dispersion and result in cloudy filtrates. Extractants containing chloride cause problems if NO_3-N is measured by ion chromatography or ion selective electrode because chloride can interfere with analysis of NO_3-N by these methods. 0.04 M ammonium sulfate, $(NH_4)_2SO_4$ is the preferred extractant for nitrate selective electrode (Griffin et al., 1995). Other extractants include 0.025M $Al_2(SO_4)_3$, 1% $KAl(SO_4)_2$, 0.025M $Al_2(SO_4)_3$ – 0.025M Ag_2SO_4 – 0.005M H_3BO_3 (pH3), 0.01M $CuSO_4$, 0.2% or saturated $CaSO_4$, 0.01M sodium citrate and 0.05M K_2SO_4 (Thomas, 1986).
- **Nitrate standard** – Check the NO_3-N concentration indicated on the label of nitrate standard when calibrating NO_3-N (e.g., 150ppm NO_3- standard is 34ppm NO_3-N).
- **Measurement unit** – The nitrate meter can be set to ppm (equivalent to mg/L) NO_3- or NO_3-N. Refer to meter manual for the measurement unit setting. If the meter measurement unit is set to ppm NO_3-N and 150ppm NO_3- standard is placed into the sensor, 34ppm NO_3-N reading will be displayed during calibration.

Reference

1. Bagshaw, J., Moody, P., and Pattison T., (2010) Soil health for vegetable production in Australia—Part 4: Measuring soil health. The State of Queensland, Department of Employment, Economic Development and Innovation
2. Geisseler, Daniel and Horwath, William. Sampling for Soil Nitrate Determination. Fertilizer Research and Education Program.
3. Griffin, G., Jokela, W., Ross, D., Pettinelli, D., Morris, T., and Wolf, A. (2009). Chapter 4 Recommended Soil Nitrate Tests. Recommended Soil Testing Procedures for the Northeastern United States. Cooperative Bulletin No. 493.
4. Thomas, J. (1986). Ion Selective Electrode Reviews, Volume 7. UK: Pergamon Press

REV 0, 4 AUGUST 2015

Nitrate Ion Meter for soil B-742

Measurement range: 30~600 ppm (NO3-), 6.8~140 ppm (NO3--N), 3.4~68 kg/10a (NO3--N)

[Accessories included]

- Nitrate Ion Meter for soil B-742
- Standard solution for soil (30 ppm, 300 ppm) (14 mL)
- 2 CR2032 batteries
- Instruction manual
- 5 Pipettes
- Cleaning solution bottle (250 mL)
- 3 Extraction bottles (100 mL)
- 2 sets of spoon for soil sampling
- Tweezers
- Sampling sheet B
- 2 Sampling sheet holders
- Quick manual
- Carrying case

LAQUAtwin Pocket Ion Meters Lineup

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