On-Farm Nitrogen Determination in Plant Sap, Soil, and Water

Fact Sheet 5

Plant Sap N Determination

Procedure

1. Sample a minimum of 20 plants from each field or management unit. See the chart below for the plant part to sample for each crop type. Always sample during the same time of day (preferably between 8 a.m. and 2 p.m.) to minimize variability.

Crop	Plant Part
Broccoli	Whole petioles (leaf stem) of youngest fully expanded leaf
Brussels Sprouts	Mid-rib of youngest fully expanded leaf
Cabbage	Mid-rib of wrapper leaf
Cauliflower	Mid-rib of youngest fully expanded leaf
Celery	Portion below first node of recently expanded leaf
Lettuce	Mid-rib of youngest fully expanded leaf
Spinach	Petiole of youngest mature leaf
Onion	Roots (washed with water and hand dried)

2. Avoid moisture loss from the tissue samples by keeping them in plastic bags on ice until analysis. Samples can be stored on ice for 6-8 hours without significantly affecting nitrate concentration.
3. Extract the sap from the selected plant part using a garlic press or plant press. Use the same amount of pressure to extract the sap from each of the 20 samples into a clean container. Mix and allow the sap to come to room temperature before analyzing.
4. A Cardy® nitrate meter or Merck Reflectoquant® Analysis System can be used to analyze the sap. Follow the respective meter directions for analysis. Samples may need to be diluted with distilled water if the nitrate concentration exceeds the testing capacity of the meter.

Interpretation

Nitrate-nitrogen (NO_3-N) sufficiency values for dry tissue and fresh sap samples

Crop	Growth Stage	NO_3-N Concentration	
		Dry Tissue[1]	Fresh Sap
Broccoli	mid-growth button formation preharvest	10,000 -20,000 8,000 - 15,000 5,000 - 8,000	1,000 - 1,600 800 - 1,200 600 - 1,000
Brussels Sprouts	mid-growth late growth	9,000 4,000	
Cabbage	10-12 leaves mid-growth (folding) early heading preharvest	8,000 6,000 4,000 3,000	 1,200 - 1,500 1,000 - 1,200 700 - 900 (mid heading)
Cauliflower	mid-growth (folding) button formation curd development preharvest	7,000 6,000 2,500 1,500	1,000 - 1,600 700 - 1,000 500 - 800
Celery	mid-growth preharvest	7,000 - 10,000 6,000 - 8,000	600 - 800 400 - 600
Lettuce	early head formation preharvest	7,000 - 12,000 6,000 - 10,000	400 - 600 350 - 500
Spinach	mid-growth	8,000	
Onion	early bulbing	5,000 - 7,000	350 - 500

[1]Lab analyzed.

Monterey County Water Resources Agency

Santa Clara Valley Water District

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Fact Sheet 5

Soil NO_3-N "Quick Test" Protocol

Procedure

1. Dissolve 5.6 grams of $CaCl_2$ in 1-gallon of distilled water to make 0.01 M $CaCl_2$ solution.
2. In a clean container, collect a composite soil sample that is representative of the main active root zone of the crop. Don't include the top 2 inches of soil since it may be high in NO_3-N but too dry for active root growth. Blend soil sample thoroughly.
3. Fill two 50-mL centrifuge tubes to the 30-mL level with the 0.01 M $CaCl_2$ solution. The calcium will help the soil settle to the bottom of the tube. (Duplicate samples—two tubes for each soil sample—are tested for each field to minimize the variability inherent in soil sampling.)
4. Add field-moist soil to the tube until the liquid level rises to 40 mL. Cap tightly and shake vigorously until the soil is thoroughly dispersed. Let sit until soil settles.
5. When the solution is reasonably clear, dip a Merckoquant® nitrate test strip into the solution for one second, shake off excess solution, and wait 60 seconds. Estimate nitrate concentration using the color chart provided.

Interpretation

The test strips measure the parts per million (ppm) nitrate (NO_3) in the solution. To approximate conversion of the reading to ppm nitrate-nitrogen (NO_3-N) for dry soil requires a correction factor based on soil texture and moisture.

test strip reading (ppm NO_3) ÷ correction factor = ppm NO_3-N in dry soil

Correction Factor		
Soil Texture	**Moist Soil**	**Dry Soil**
Sand	2.3	2.6
Loam	2.0	2.4
Clay	1.7	2.2

Levels less than 10 ppm NO_3-N would be considered low; levels above 20 ppm NO_3-N are adequate to meet immediate crop needs. Caution: Low soil NO_3-N levels late in the cropping season may not indicate insufficient N, rather they may indicate highly efficient crop uptake. Use plant tissue testing to confirm low N status.

Water N Determination

Procedure

1. Dip a Merckoquant® nitrate test strip into the water for one second, shake off excess solution, and wait 60 seconds. Estimate nitrate concentration using the color chart provided. (Note: concentrations can vary throughout the season.)

Strip reading (ppm NO_3) ÷ 4.43 = ppm NO_3-N

ppm NO_3-N x 1 inch x 0.227 = lbs of NO_3-N per acre-inch of water applied

A Merck RQflex® meter can be used to obtain more accurate color interpretations. Follow the meter instructions.

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These nitrate determination methods were excerpted from the University of California Division of Agriculture and Natural Resources "Production Guide: Nitrogen and Water Management for Coastal Cool-Season Vegetables." This publication can be ordered from ANR Communication Services at 800-994-8849 or on the Internet at http://commserv.ucdavis.edu/ucce/.

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On-Farm Nitrogen Determination in Plant Sap, Soil, and Water

Materials List and Ordering Information

Tools for N Test Procedures

"Quick-Test" Kits

individual test strips, calcium chloride, centrifuge tubes
FREE while supplies last:
Santa Clara Valley Water District . . . . . (408) 265-2607, ext. 2723
Monterey County Water Resources Agency . . . . . .(831) 755-4860
University of California Cooperative Extension Offices
Santa Clara County . . . . . (408) 299-2635, ext. 4
Monterey County . . . . . .(831) 759-7350

Nitrate Test Strips

VWR Scientific
Part No. EM-10020-1
$38.54 for pack of 100
Telephone (800) 932-5000

Calcium Chloride

VWR Scientific
Part No. JT1332-1
$54.30 for 500 grams
Telephone (800) 932-5000

Centrifuge Tubes

VWR Scientific
Part No. 20171-034
$103.00 for case of 500 50-mL tubes
Telephone (800) 932-5000

Soil Probes

JMC Soil Investigation Equipment
Part No. 031 (12" samples) longer probes available
Low cost sampler with foot pedal $56.65 (without foot pedal $31.45)
Telephone (800) 247-6630

Cardy Nitrate Meter

Horiba Instruments
Part No. 352343
$249.00 (includes standard solutions)
Telephone (800) 446-7422

Merck Reflectoquant

VWR Scientific
Part No. EM-16950-1 (meter)
Part No. EM-16995-1 (nitrate test strips)
$495.00 for RQflex meter
$48.61 for nitrate test strips (test strips for other parameters are available)
Telephone (800) 932-5000

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