

Nitrate Quick Test SOP Appendix A:
Cost Analysis of Nitrate Quick Test Program:
What are the True Costs to Growers?

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The goal of this study is to determine the cost of implementing a nitrate quick test (NQT) program for a growing operation. Given the number of variables involved in an NQT program, it is important that growers evaluate their goals for this program and determine their needs. The following study will give growers the tools needed to evaluate and establish a cost effective nitrate quick test program.

Nitrate Quick Test Strips:

Although the University of California Cooperative Extension identified three brands of nitrate quick tests to adequately estimate soil nitrate levels, research for this cost analysis found that most industry professionals rely on the EM Quant Nitrate Test Strips (Merckoquant NO₃/NO₂). This test strip allows growers to evaluate nitrate levels on a real time basis at a smaller concentration than the other brands and does not require any additional calculations to determine the nitrate (NO₃) concentration in soil or water. It is important to note that these test strips may not be effective for soils with lower nitrate levels as they are unable to measure nitrate levels lower than 10ppm. Additionally, the Merckoquant test strips DO require additional calculations if concentration of nitrate-nitrogen (NO₃-N) is desired, which is the case for growers who are using NQT to determine residual soil nitrate-nitrogen concentration and make fertilizer management decisions to match crop demand.

All prices listed in this report are considered retail prices. Growers will need to contact vendors directly for bulk pricing as discount varies based on quantity and vendor.

Nitrate Test Strip Pricing and Details

Brand	Measurement	Price	# of Strips	Price/Strip	Retailer
Merckoquant NO ₃ /NO ₂ ²	NO3 (10-500ppm)	\$68.00	100	\$0.68	Cole Parmer
LaMotte Instatest NO ₃ /NO ₂ ¹	NO3-N (0-50ppm)	\$11.70	50	\$0.23	Ben Meadows
Hach Aquachek ¹	NO3-N (0-50ppm)	\$19.95	25	\$0.80	Hach Company

¹LaMotte and Hach test strips measure NO₃-N (i.e. crop-available nitrogen); some calculations will be necessary to determine NO₃ concentration.

²The Merckoquant test strips measure NO₃ concentration; some calculations will be required to determine soil NO₃-N concentration (i.e. crop-available nitrogen). These test strips will also require the added cost of refrigeration, either in an office or vehicle refrigeration unit.

Nitrate Test Strip Cost Evaluation

Brand	Price for 100 strips	Price for 500 strips	Price for 5,000 strips
Merckoquant NO ₃ /NO ₂	\$68.00	\$340.00	\$3,400.00
LaMotte Instatest NO ₃ /NO ₂	\$23.40	\$117.00	\$1,170.00
Hach Aquachek	\$79.80	\$399.00	\$3,990.00

Required Nitrate Quick Test Supplies:

When determining the test supplies appropriate for an operation, a series of questions need to be answered. If testing will be done in the field, a vehicle refrigerator will be needed to refrigerate Merckoquant test strips. A grower will have to decide between round or flat bottom centrifuge tubes and the quantity of tubes. You can safely estimate that each centrifuge tube has a lifetime of 100 samples. Round bottom centrifuge tubes cost less than flat bottom but will require a tube rack, while flat bottom tubes could be free standing eliminating the need for a tube rack.

Additionally, acquiring laboratory grade calcium chloride may pose a challenge for some growers as it can be considered a hazardous material. Aquarium calcium chloride, which can be purchased at most pet stores, has the necessary properties to create a soil suspension without adding the complex ordering requirements of laboratory grade chemicals.

In the three charts below, the required supplies are broken down as supplies purchased one-time, supplies to be replaced after 100 uses and supplies that are completely disposable.

Nitrate Quick Test Supplies to be Purchased Once

	Supply	Price	Quantity	Retailer
1	Centrifuge Tube Rack (Holds 16 tubes) ¹	\$31.33-\$42.70	1	Cole Parmer, Amazon
2	Scale	\$59.95-\$150.00	1	Amazon
3	Truck Refrigerator ²	\$105.95-\$200.00	1	Amazon
4	Long Handled Sampling Trowel ³	\$23.00-\$25.00	1	Amazon
5	Soil Probe ³	\$29.95-\$60.00	1	Amazon
6	Bucket	\$2.78	1	Home Depot

¹ A centrifuge tube rack is only required if a grower is using a round bottom centrifuge tube but may also be helpful when organizing tubes even when using flat bottom centrifuge tubes.

² The truck refrigerator is only required for the Merckoquant test strips.

³ A grower should decide whether to use a sampling trowel or soil probe. Although soil probes are able to take a deeper sample, they may be difficult to use in heavy clay soils. Soil probes may also cause compaction within the sample.

Nitrate Quick Test Supplies to be replaced after Approximately 100 Uses

	Supply	Price	Quantity/pack	Retailer
7	Centrifuge Tubes (round bottom) ¹	\$164.00	500	Cole Parmer
8	Centrifuge Tubes (flat bottom) ¹	\$201.00	500	Cole Parmer

*A grower should select one type of centrifuge tube and one type of calcium chloride.

* Please note that sites such as Amazon.com carry centrifuge tubes in smaller quantity making it a lower cost.

*Although centrifuge tubes are reusable items, we can estimate that one tube can be used for approximately 100 samples before needing to be replaced.

¹ A centrifuge tube rack is needed when using round bottom centrifuge tubes but may also be helpful when organizing samples even when using flat bottom tubes.

Nitrate Quick Test Supplies that are Disposable

	Supply	Price	Quantity/pack	Retailer
9	Paper Bags (lunch bag size) ¹	\$10.99-\$12.99	500	Amazon.com
10	Calcium Chloride (Laboratory grade) ^{2,3}	\$55.00-\$57.00	500 grams	Cole Parmer
11	Calcium Chloride (aquarium grade) ^{2,3}	\$8.99-\$16.99	800 grams	Amazon.com
12	Distilled Water ³	\$1.89	1 gallon	Orchard Supply

¹ One paper bag will be used per soil sample.

² Laboratory grade calcium chloride is not necessary for this use and may require additional paperwork with a vendor as it is considered a hazardous material. Aquarium grade calcium chloride is just as effective and can be purchased from any aquarium store.

³ One gallon of distilled water and 5.6 grams of calcium chloride will be sufficient for approximately 125 samples.

Supply Cost Estimates

The charts included below outline the estimated cost of supplies to maintain a nitrate quick test program. The range of costs is based on the high and low retail prices included in the charts above. To calculate the numbers below we used item numbers 1, 2, 3, 4, 6, 7, 9, 11, and 12 from the charts above as well as the Merckoquant test strips as they are the most widely used by both researchers and practitioners in the industry.

A few things to remember...

-When considering the cost of these supplies, it is important to remember that the upfront cost for the one-time purchase supplies will be the same no matter how many tests a grower plans run. However, the more tests a grower runs, the more these items depreciate and their overall cost per sample goes down.

-We can estimate that each centrifuge tube will last for approximately 100 tests before needing to be replaced. Taking this into consideration, a bag of 500 centrifuge tubes will last for 5,000 samples. After 5,000 samples a grower should consider replacing centrifuge tubes.

-One gallon of distilled water and 5.6 grams of calcium chloride will be sufficient for approximately 125 tests. If a grower purchases 500 grams of calcium chloride, and it is stored correctly, they would have enough calcium chloride to complete over 11,000 samples.

Supply Cost Estimate if a Grower Plans to Complete 100 Samples

Supplies for 100 Samples	Price per Sample	Price per 100 Samples
One Time Purchase supplies	\$2.30-\$3.61	\$229.96-\$361.43
100 Use supplies	\$1.64	\$164.00
Disposable supplies	\$0.90-\$1.00	\$89.87-\$99.87
Total	\$4.84-\$6.25	\$483.83-\$625.30

Supply Cost Estimate if a Grower Plans to Complete 500 Samples

All Supplies for 500 Samples	Price per Sample	Price per 500 Samples
One Time Purchase supplies	\$0.46-\$0.72	\$229.96-\$361.43
100 Use supplies	\$0.33	\$164.00
Disposable supplies	\$0.74-\$0.76	\$367.54-\$377.54
Total	\$1.53-\$1.81	\$761.50-\$902.97

Supply Cost Estimate if a Grower Plans to Complete 5,000 Samples

All Supplies for 5,000 Samples	Price per Sample	Price per 5,000 Samples
One Time Purchase supplies	\$0.05-\$0.07	\$229.96-\$361.43
100 Use supplies	\$0.03	\$164.00
Disposable supplies	\$0.72-\$0.73	\$3,594.49-\$3,622.49
Total	\$0.80-\$0.83	\$3,988.45-\$4,147.92

Other Associated Costs of Sampling

Labor Considerations:

There is no consensus or standard operating procedure on sampling methodology for nitrate quick tests. Different fields, blocks and operations may take samples differently depending on the end goal. Samplers may pull anywhere from 8-20 soil sub samples to create a composite sample for testing a block. Others may take three separate samples at different points and test each one to determine whether nitrate content is consistent throughout the block. It is important to note that the more samples taken, the less variability you need to be concerned with, and the more accurate and informative the results from the NQT. Other contributing factors to take into consideration:

- Testing time may vary depending on soil type and absorption rate. A reasonable expectation of time per sample will range from 30 minutes to one hour, but may be longer for fields with more than one soil type, clayey soil that is difficult to sample and requires more time to settle in solution, high spatial variability is soil inputs and/or crop/soil environment, or crop blocks that cover greater area.
- Travel time will vary greatly depending on proximity of ranches, samplers with other tasks, and whether the sampler was already on the ranch for another task.

Estimated Labor Costs

Labor Type	Cost/hour
Grower	\$125.00
Consultant	\$70.00-\$100.00
Sampler/other staff	\$18.75-\$25.00

*Staff wage estimated at \$15.00 - \$20.00 per hour with a 25% estimate for benefits. The cost of benefits will vary based on the packages offered by the operation.

Transportation Considerations:

The costs of transportation will vary with each operation. If a vehicle has to be purchased to complete these samples, it will obviously cause a substantial increase in the cost of a sample. Each operation will have to evaluate their transportation cost as it is heavily dependent on the number of samples and the distance between ranches or blocks.

Estimated Transportation Costs

Transportation	Additional Cost (estimate)
Operation has vehicle available	Current cost to grower
Operation purchases new truck (4x4) ¹	\$27,000-35,000
Operation purchases gently used ²	\$18,000-25,000
Operation reimburses employee ³	\$0.56/mile

¹ New vehicle cost based on Ford F-150 STX 4x4 model

² Used vehicle price based on Kelley Blue Book estimate for F-150 STX 4x4 model with approximately 30,000 miles

³ Reimburse price based on IRS standard mileage rate for 2014

Space Considerations:

Cost for space for completing nitrate quick tests will also vary by operation. A grower who decides to complete samples in the field or truck will not need to have the office or lab space to complete testing. If a grower decides to complete tests in an office or lab space, we estimate that they will need a 6'x3' space for 25 samples. Agricultural office space in the Salinas area rents for approximately \$1.00-\$1.30 sq ft.

Space	Estimated Cost/sqft for ag office space	Additional sqft needed for 25 samples	price for space for 25 sample	100	500	5000
Testing completed in Field or Space Already Available	\$0.00	0	0	0	0	0
Testing completed at Office	\$1.15	18	\$20.70	\$82.80	\$414.00	\$4,140.00

*Office or lab space may not be required. Space required depends on operation preference.

*It is not likely that all samples will be processed at the same time leaving room for overlap on space requirements.

Alternatives:

- The grower can contact their fertilizer supplier or crop service company to inquire about testing. Prices vary.
- The grower can purchase testing supplies from Wilbur Ellis. Some custom sampling companies may also offer testing supplies.
- The grower could hire a third party sampling company to run nitrate quick tests. Food Safety Sampling offers these services. Prices vary based on number of samples.
- Some contractors and service companies also offer rapid result nitrate testing with in house test equipment. NH3 and Morgan Consulting offer this service. Prices vary.

It is important to note that a nitrate quick test program will not be cost effective if the test is not performed correctly. Please refer to 'How to Use the Nitrate Quick Test' for detailed information on effective sampling and processing procedures for NQT.