

**HI 38050**  
**Nitrate Test Kit**  
**for Soil and Irrig-**  
**ation Water**

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# **Nitrate Test**

# **Handbook**

**Soil Science**  
**and Management**



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## Index

INTRODUCTION .....	4
THE NITROGEN CYCLE .....	4
WHY AND WHEN TO TEST FOR NITROGEN.....	5
HOW TO COLLECT SOIL SAMPLES .....	5
FERTILIZATION RECOMMENDATIONS .....	6
HOW TO PROGRAM NITROGEN FERTILIZATION .....	7
CONVERSION FACTORS .....	8
WARNING .....	8
CHEMICAL REACTION .....	8
SPECIFICATIONS.....	8
TEST PROCEDURE FOR DETERMINING NITRATE IN IRRIGATION WATER.....	9
TEST PROCEDURE FOR DETERMINING NITRATE IN SOIL SAMPLES.....	10
Calcium Sulfate Extraction .....	10
Nitrate Determination .....	11

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Dear Customer,

Thank you for choosing a Hanna Instruments product.

Please read this instruction manual carefully before using these instruments. This manual will provide you with the necessary information for correct use of these instruments, as well as a precise idea of their versatility.

If you need additional technical information, do not hesitate to e-mail us at [tech@hannainst.com](mailto:tech@hannainst.com) or view our worldwide contact list at [www.hannainst.com](http://www.hannainst.com).

Remove the test kit from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any noticeable damage, notify your Dealer or the nearest Hanna office immediately.

Each kit is supplied with:

- **HI 38050-0** Nitrate Reagent packets (200 pcs.);
- 1 checker disc (containing the **38050** disc);
- 2 glass vials with caps.

**Extraction Kit:**

- Calcium Sulfate, 1 bottle (10 g);
- Demineralizer Bottle with filter cap for about 12 liters of deionized water (depending on the hardness level of water to be treated);
- 1 2-mm soil sieve;
- 1 plastic test tube (50 mL) with screw cap;
- 1 large funnel;
- filter paper discs  $\varnothing$  120 mm (100 pcs.);
- 1 brush;
- 2 calibrated plastic vessels (50 mL) with cap;
- 1 sample cup (2 g);
- 1 plastic pipette (3 mL);
- 2 spoons.

**Note:** Any damaged or defective item must be returned in its original packing materials.

## INTRODUCTION

Nitrogen (N) is an indispensable element for plant life. It is present in proteins, vitamins, chlorophyll, etc. Nitrogen allows the development of the vegetative activity of the plant, in particular, causes lengthening of trunks and sprouts and increases the production of foliage and fruit. It directly increases the crop yield, though the crop quality depends on other elements.

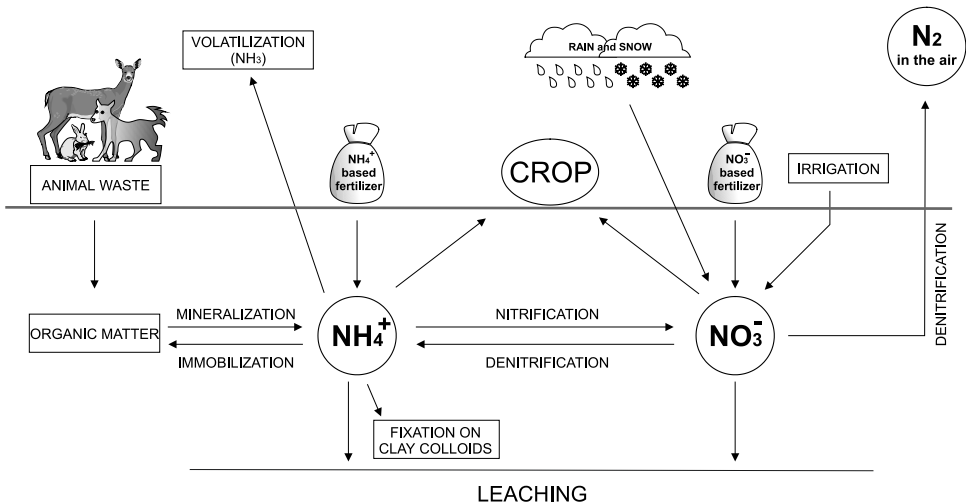
Nitrogen, mostly absorbed by plants as nitrate ( $\text{NO}_3^-$ ), derives from the mineralization of organic matter and the application of fertilizers. Nitrate-nitrogen is not durable in soil. The large amount required for crop production, makes it necessary to administer this element in moderate quantities during the crop growth season.

An excess of Nitrogen weakens plants' structure creating an unbalanced relationship between the green and wooden parts. In addition, the plant becomes less resistant to diseases. Furthermore excessive nitrogen fertilization can contaminate groundwater and cause environmental problems.

The Hanna Nitrate Test Kit for Soil and Irrigation Water makes it possible to determine the need for nitrogen fertilization. It also obtains the best crop response and avoids over-fertilization.

## THE NITROGEN CYCLE

Nitrogen is the most abundant element present on our planet and can be found in many different forms. Only a very small part of the total nitrogen is available for plant growth. The exchanges between available and unavailable nitrogen combine to form a complex system which is called the nitrogen cycle.



**Note:** Legumes (soybean, pea, clover, alfalfa, etc.) are able to take atmospheric nitrogen by a symbiotic association with Rhizobium bacteria.

A very important source of nitrogen available for plants is the decomposition (mineralization and nitrification) of organic matter, the so called “turnover”. However only part of the organic matter decomposes during the crop growth season. The decomposition rate depends strongly on the local climate, the physical structure and microbiological activities in the soil, thus it varies from year to year. Other important sources of nitrogen are fertilization and irrigation when nitrogen compounds are present in the irrigation water. Even rain and snow can contribute, dissolving the nitrate, nitrite and ammonia normally present in the atmosphere and carrying them to the soil.

Available nitrate-nitrogen can be lost from the soil in several ways. The most significant ones are leaching, which occurs during heavy rainfall or where excessive irrigation is used. Another is assimilation by crops. It is estimated that in natural soils (woods, forests) about 80% of the absorbed nitrogen is replenished when trees shed their leaves. In case of crops, the assimilated nitrogen is lost from soil during harvesting.

Testing the soil during the crop cycle is a useful tool for next cultivation, in order to plan fertilization and to know the residues of fertilizers in relation to the crop, tillage and climate. An analysis can highlight shortages and help in understanding the causes of an abnormal growth.

The Hanna nitrate-nitrogen test can be performed the whole year round, but testing is particularly recommended during spring and late spring, when rainfall and temperature-related bursts of microbiological activity often have great influence on the availability of nitrate-nitrogen.

## WHY AND WHEN TO TEST FOR NITROGEN

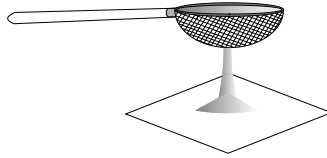
## HOW TO COLLECT SOIL SAMPLES

- 1) Soil Sample Extraction
  - Within a large homogeneous area, take 1 or 2 samples per 1000 m<sup>2</sup> (0.25 acre).
  - Even for smaller areas, 2 samples are recommended (the more samples, the better the end-results, because the end sample is more representative).
  - For a small garden or plot, 1 sample is sufficient.
- 2) Avoid extracting samples from soil presenting obvious anomalies and from border areas (near ditches and roads).
- 3) Sample quantity:  
Take the same quantity of soil for each sample. For example, use bags with similar dimensions (1 bag per sample).
- 4) Depth of extraction:  
Sample the top 30 cm (12”) of soil.
- 5) Mix all the samples together to obtain a homogeneous mixture of soil, discarding stones and vegetable residues.

- 6) From this mixture, take the quantity of soil that you need for the analyses.
- 7) Crumble the large chunks and distribute the soil sample on plastic to air dry it. The sample dries faster if a fan is used to move air across the sample.
- 8) Use a small bar to crush the air dried sample and pass it through the 2-mm soil sieve.

Do not store the samples longer than 24 hours in a closed plastic bag. Store the sample in a cold place and out of direct sunlight, if it can not be dried immediately.

Do not expose the soil to direct sunlight or any heat font.



## FERTILIZATION RECOMMENDATIONS

Before sowing or transferring plants, use a slow-acting fertilizer to enrich the soil for the long term. Adding organic substances (such as manure and compost) helps to increase the soil fertility. In case of lack of nitrogen during the crop growth season, use fertilizers containing nitrate. If necessary add the fertilizer before sprouting or wheat raising, or as a side dressing while crop is growing. Do not give nitrate at the end of the plant cycle to crops such as lettuce (where the product is the vegetable part), in order to avoid its accumulation in the leaves (nitrate is carcinogenic).

The quantity of fertilizer to be added to the soil depends not only on the chemical state of the soil but also on factors such as present cultivation, local climate, the physical structure and microbiological activities. If the soil is irrigated, also nitrate dissolved in the water contributes to the nitrogen fertility (each ppm of a nutrient dissolved corresponds to 5.0 kg/ha if 50 cm of irrigation water is applied), so does natural precipitation (about 5-15 kg/ha a year average, up to 50-60 kg/ha in industrialized areas).

Test results indicate the actual nitrate concentration and allow a fast intervention if the concentration is insufficient for crop. If the test results are lower than 10 ppm N-NO<sub>3</sub> (as mg/kg soil) early in the growing season, the nitrate-nitrogen should be considered deficient and a yield reduction can be expected. A first intervention with a direct available nitrate fertilizer (about 100 kg N/ha) is recommended.

The exact amount of fertilizer required depends on the type of crop. A nitrogen concentration between 20 and 25 ppm, for example, is considered as optimal for corn. Above 26 ppm, addition of more N-fertilizer is not likely to increase yield.

To adjust the nitrogen concentration above 10 ppm of N-NO<sub>3</sub> in soil, add 11 kg N/ha of side-dressing, for each incremental ppm of nitrate-nitrogen concentration. See the

Table below for the fertilizer recommendations for Corn.

soil N-NO <sub>3</sub> (ppm)	fertilizer recommendation (kg N/ha)	soil N-NO <sub>3</sub> (ppm)	fertilizer recommendation (kg N/ha)
<10	100-150	18	32-92
10	120-180	19	21-81
11	109-169	20	10-70
12	98-158	21	9-59
13	87-147	22	0-48
14	76-136	23	0-37
15	65-125	24	0-26
16	54-114	25	0-15
17	43-108	26	0

If soil has been previously fertilized (> 140 kg N/ha) with slow decomposing fertilizers (e.g. manure or anhydrous ammonium), then use the lower value of recommended fertilizer. Take more samples to assure your mixed sample is a representative one for your field.

## HOW TO PROGRAM NITROGEN FERTILIZATION

When this test is used for the first time, it is better to perform it during a complete growth cycle without changing the normal fertilization program. This helps to familiarize oneself with this test and provides a good reference point in order to improve the fertilization program. In the subsequent growth cycle, preplant fertilization rate should be reduced by approximately 30%. It is suggested to periodically check possible nitrogen requirements and to add extra nitrogen if necessary.

Attention should be paid in case of temporary changes to normal climatic conditions such as lower temperatures (with a consequent reduction of the turnover of organic matter) or heavy rainfalls, when nitrate-nitrogen concentrations are expected to be very low or even absent. After the weather returns to normal, it should be checked that the nitrate levels are also reinstated.

Whenever possible it is recommended to carry out some fertilization experiments on small 'strips' of the field.

When this test kit is used over several years, it becomes a powerful tool to optimize the nitrogen fertilization program and allows a fast intervention if the nitrogen concentration becomes insufficient.

## CONVERSION FACTORS

1 kg	2.205 lb.
1 ha	2.471 acre
1 kg/ha	0.891 lb./acre
1 ppm (soil)	1 mg/kg
1 ppm (irrigation water)	1 mg/L
1 ppm N	4.43 ppm NO <sub>3</sub>

## WARNING

This test gives accurate results for most soil types, nevertheless, some local circumstances can cause erroneous readings. Therefore use this test always with caution.

Whereas an insufficient dose of nutrients decreases the potential crop production, an excess can have a detrimental effect on the physiology of the plants and the crop quality. In addition, too much fertilization is unnecessarily costly as well as harmful to the environment. Hence, only after a technical and economical evaluation, it is possible to choose the proper quantity of fertilizer to be added.

## CHEMICAL REACTION

Nitrate is reduced to nitrite in the presence of Cadmium. The nitrite thus produced reacts with the reagent to yield an orange compound. The amount of color developed is proportional to the concentration of nitrate present in the aqueous sample.

## SPECIFICATIONS

Range	<b>IW:</b> 0-50 mg/L (ppm) as N-NO <sub>3</sub> <sup>-</sup> <b>Soil:</b> 0-60 mg/L (ppm) as N-NO <sub>3</sub> <sup>-</sup>
Smallest Increment	<b>IW:</b> 1 mg/L (ppm) N-NO <sub>3</sub> <sup>-</sup> <b>Soil:</b> 2 mg/L (ppm) N-NO <sub>3</sub> <sup>-</sup>
Analysis Method	Colorimetric
Sample Size	5 mL (IW) 10 g of soil (Soil)
Number of Tests	100 (IW), 100 (Soil)
Case Dimensions	235x175x115 mm (9.2x6.9x4.5") 235x175x115 mm (9.2x6.9x4.5")
Shipping Weight	1026 g (36.2 oz.)

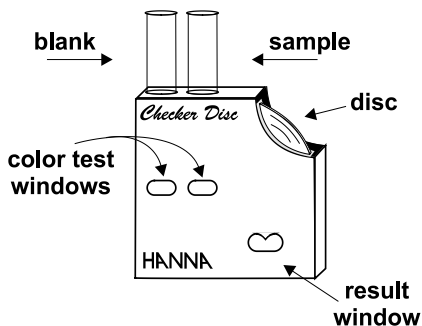
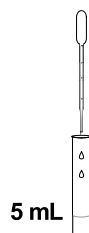
**Note:** IW is Irrigation Water



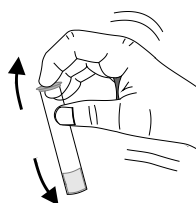
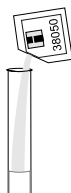
# TEST PROCEDURE FOR DETERMINING NITRATE IN IRRIGA- TION WATER

READ THE ENTIRE INSTRUCTIONS BEFORE USING THE KIT

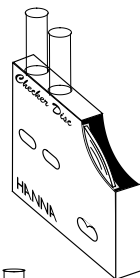
- 1- Using the plastic pipette, fill each glass vial with 5 mL of water sample (up to the mark).
- 2- Insert one of them into the left hand opening of the checker disc. This is the blank.



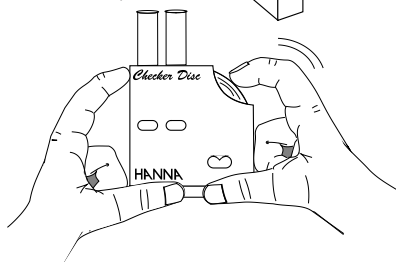
- 3- Add to the other glass vial 1 packet of **HI 38050-0** reagent. Replace the cap, shake vigorously for 1 minute and wait for 5 minutes. This is the reacted sample.



- 4- Remove the cap and insert the reacted sample into the right hand opening of the checker disc.
- 5- Hold the checker disc so that a light source illuminates the samples from the back of the windows.



- 6- Keep the checker disc at a distance of 30-40 cm (12-16") from the eyes to match the color. Rotate the disc while looking at the color test windows and stop when you find the color match. Read the value in the result window directly in mg/L (ppm) of nitrate-nitrogen ( $\text{N-NO}_3^-$ ). Multiply the reading by 4.43 to obtain mg/L of nitrate ( $\text{NO}_3^-$ ).



**Note:** Perform the reading three times and take the average value (divide by 3 the sum of the three numbers).

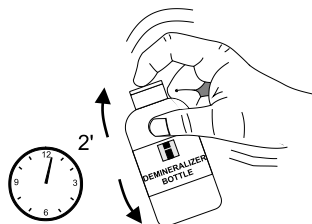
# TEST PROCEDURE FOR DETERMINING NITRATE IN SOIL SAMPLES

## CALCIUM SULFATE EXTRACTION

7- Remove the cap and fill the Demineralizer Bottle with tap water.



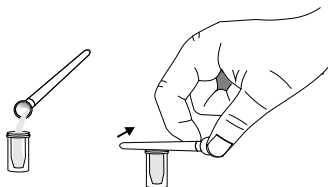
8- Replace the cap and shake gently for at least 2 minutes. The demineralized water is now ready.



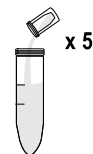
9- Flip open the top of the Demineralizer Bottle cap. Squeeze gently the bottle to add demineralized water to the test tube up to the 20 mL mark.



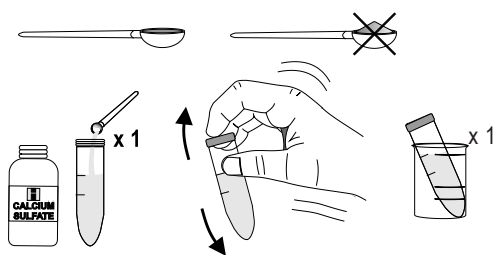
10- Use the spoon to fill the sample cup with the sieved soil sample and level the sample in the cup by discarding the excess soil with the spoon handle.



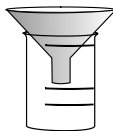
11- Add to the tube 5 measures of the sample cup of sieved soil sample.



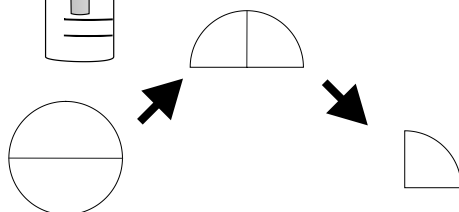
12- Add 1 level spoon of Calcium Sulfate. Cap the tube and mix by shaking it up and down for 1 minute. Place the tube into one beaker.



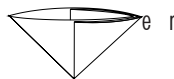
13- Place the funnel on the top of the other beaker.



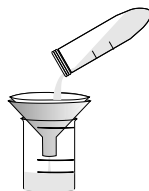
14- Fold a filter paper disc twice as shown in the figure.



15-Separate one side from the other three to form a cone.

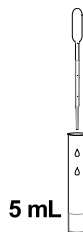


16-Place the folded filter disc into the funnel and filter the sample. The extracted sample in the beaker is now ready for analysis.



### NITRATE DETERMINATION

17-Use a pipette to fill each glass vial with 5 mL of the extracted sample and follow the test procedure as for irrigation water (steps 2 to 5).



18-Keep it at a distance of 30-40 cm (12-16") from the eyes to match the color. Rotate the disc while looking at the color test windows and stop when you find the color match.

19-Read the value in the result window and multiply it by 2 to obtain mg/L (ppm) of nitrate-nitrogen ( $\text{N-NO}_3^-$ ). Multiply the reading value by 8.86 to obtain mg/L of nitrate ( $\text{NO}_3^-$ ).

**For best results:** Intensely colored samples will make the color matching difficult and they should be adequately treated before performing the test. Suspended matter in large amounts should be removed by prior filtration.

**Caution:** Ultraviolet radiation may cause fading of colors. When not in use, keep the disc protected from light, in a cool and dry place.

**Interference:** Strong oxidizing and reducing substances; ferric ion (positive interference); chloride above 100 ppm (negative interference).



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