OSU Soil Test for Nitrate Nitrogen

A soil test for Nitrate Nitrogen (nitrate-N) is now available through the Soil Testing Laboratory at OSU.

This soil test is recommended only for certain crops, soils, and areas as noted below.

Recent research, particularly in the irrigated area of Central Washington, has shown that the determination of the total nitrate nitrogen in the "root zone" provides an indicator which can be used as a basis for estimating fertilizer nitrogen needs for certain crops and soils.

Where Does N for Crop Come From?

The N requirements of the crop are supplied largely from three sources:

$$N \text{ for Crop} = \underset{\text{Soil N}}{\text{Available}} + \underset{\text{Matter N}}{\text{Organic}} + \underset{\text{N}}{\text{Fertilizer}}$$

1. *Available soil N.*

This consists of residual N from previous fertilizer applications and available N from other sources such as a previous legume crop or decomposed organic material. It is mostly in the nitrate form excepting where recent applications of ammoniacal-N have been made. Nitrate N accumulates in soils in areas of low rainfall such as Eastern Oregon, but does not accumulate under the high winter rainfall conditions prevalent in Western Oregon. A soil test for nitrate-N is useful in estimating the amount of available soil N.

2. *Organic matter N.*

This consists of organic N which is contained in organic matter and plant and animal remains in the soil. It is released at varying rates as the organic material decomposes and is not measured in the nitrate-N soil test. The nitrate-N soil test, therefore, is not reliable for soils which contain over 2% organic matter. As nearly all Western Oregon surface soils contain over 2% organic matter and any nitrate-N from the previous crop would be lost in the winter rains, the nitrate-N soil test is not recommended for Western Oregon.

Also, an appreciable amount of available N is released from organic material following certain legume crops such as alfalfa. The nitrate-N soil test is, therefore, more difficult to interpret following a crop such as alfalfa and suggested N fertilizer applications must take the N released from the plant residue into account.

3. *Fertilizer N.*

If available soil N, plus available N released from organic forms, is not adequate for optimum crop growth then additional N should be applied. With soils which have a low level of organic matter a soil test for nitrate-N is useful in predicting the N fertilizer requirement.

Where Should the Nitrate-N Soil Test Be Used?

1. *The nitrate-N soil test should be restricted to that area of Oregon east of the Cascade Mountains.*

At the present time for reasons given in the preceding section, soil tests for nitrate-N cannot be properly interpreted for Western Oregon soils.

2. *The nitrate-N soil test should be used on mineral soils in Eastern Oregon which contain less than 2% organic matter.*

Nearly all mineral soils in Eastern Oregon contain less than 2% organic matter.

Because of their high organic matter content, the nitrate-N soil test is not recommended for peat and muck soils.

3. *The nitrate-N soil test should not be used on soils where the ammonia or ammonium forms of nitrogen have been recently applied.*

In the nitrate-N soil test only the nitrate form of nitrogen is determined. At present there is no research information for Oregon or Washington which indicates a good relationship between other forms of N in the soil and crop growth.

Under soil conditions conducive to crop growth the ammonia or ammonium forms of nitrogen are converted into the nitrate form of nitrogen. Therefore, where ammonia or ammonium have been applied, *soil samples for the nitrate-N test should be taken following a growing season and prior to the application of N fertilizer.*

4. *At the present time the nitrate-N soil test is suggested for the following crops:*

Potatoes	Sweet Corn
Small Grains	Sugar Beets
Field Corn	Onions

Soil Sampling Patterns for Nitrate-N

A. *Where fields are sprinkler irrigated or dryland.*

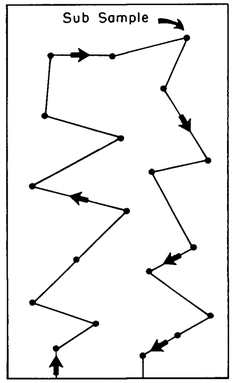

Figure 1. Random soil sampling pattern for a sprinkler irrigated or non-irrigated field or sampling area.

1. The *soil sample* consists of several *sub samples* which are removed at random from a field or area. The sub samples are mixed or *composited* to make the soil sample.
2. Each soil sample should consist of 15 to 20 sub samples from the sampling area.
3. Each soil sample should represent only *one soil type or soil condition.* Different soil types should be sampled separately. Areas with different management histories such as cropping or fertilization should be sampled separately. Sub samples should not be removed from small, unusual areas.
4. *Sample by depth.* Take samples from each foot to the depth recommended for the crop (see Table 1). All sub samples from the 0-12" depth are composited to give a 0-12" soil sample. This is repeated for the other depths. Be careful to avoid contamination of the sample.
5. Place sample in a soil sample bag. Be sure that the necessary information is printed on soil sample bag.
6. Complete Soil Sample Information sheet making sure to print in all pertinent information.
7. Mail sheet and sample to Soil Testing Laboratory, Oregon State University, Corvallis, Oregon 97331.

B. *Where fields are rill irrigated*

Rill irrigation results in an uneven distribution of nitrate in the soil. Nitrate in solution moves freely through the soil and thus tends to move outward and downward from the irrigation furrows. Nitrates which are not leached downward are deposited in "bands" near the soil surface midway between the irrigation furrows as indicated in Figure 2. Also, variable amounts of N are deposited at various depths from the surface.

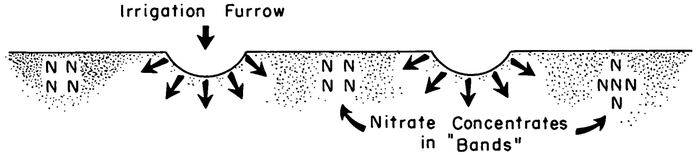

Figure 2. The movement of soil water and nitrate-N with relation to the irrigation furrow.

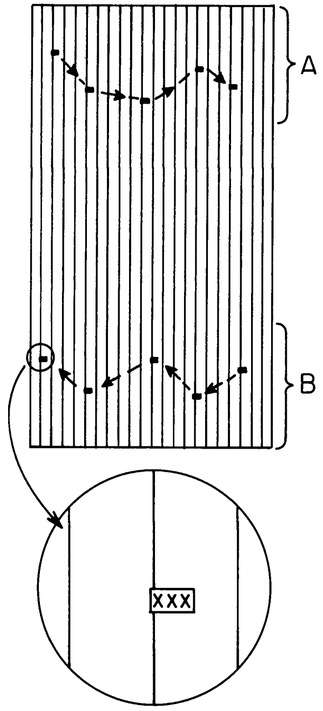

Figure 3. Sampling pattern for a rill irrigated field.

Soil Sampling A Rill Irrigated Field

The interpretation of these instructions will be easier if you refer to Figure 3.

1. Sampling should be done in late fall or early spring prior to fertilizer application.
2. Determine direction and width of row spacing for previous crop. Identification of exact location of rows is desirable but not necessary.
3. Take samples by traversing the sampling area in a direction at right angles to the rows.
4. Three sub samples (at each sampling site) are chosen systematically in a line *across* the direction of rows. The sub samples are equally spaced at a distance equal to one-fourth the row spacing of the previous crop. Thus, the three sub samples will cover one-half the distance between rows. Where rows can be identified, sub samples should be located as indicated in Figure 3.
   Where rows cannot be identified but direction of rows is known, sampling site should be located at random in a direction perpendicular to the rows.
5. Sample by depth. Take samples from each foot to the depth recommended for the crop.
6. Composite samples by depth. That is, for all sampling sites, place *all* first-foot sub samples together, mix, fill the sample bag and discard the remainder. Do the same for each soil depth which is sampled. Each soil sample should consist of at least 15 to 20 sub samples.

Note: Because of probable variation from upper to lower ends of rill irrigated fields, it would be advisable to composite A sub samples and B sub samples by foot depth increments. Keeping A and B samples separate will reveal variation in nitrogen soil test values due to irrigation.

7. Dry soil sample and forward as indicated on page 2.

Depth of Soil Sampling for Nitrate-N

Nitrate is mobile in soil and can be extracted by plant roots throughout the rooting zone of the plants.

Deeper rooting plants such as small grains and corn can remove nitrate to a five foot depth or deeper where the soil is this deep.

Shallower rooting crops, such as potatoes, probably do not remove much nitrate below a three-foot depth.

The depth of sampling for different crops is given in Table 1. In some instances the depth of sampling may be limited by soil depth. In such cases samples should be taken to the depth of the soil. If the deepest sample does not represent a one-foot soil depth this should be indicated on the information sheet.

Table 1. *Nitrate-N Soil Test Values and N Fertilization Recommendations*

Crop	Sampling Depth (Inches)	OSU soil test value for Nitrate-N (Use the value nearest your test value)	Pounds of N to Apply per Acre: On new land, or after potatoes, sugar beets, corn for silage, grass seed, or wheat with straw removed[1]	After peas, beans, alfalfa or other legume stubble	After alfalfa or other legume green manure plowed under
Irrigated	60	10	200	160	120
Semi-dwarf		20	160	120	80
Wheat and		30	120	80	40
Sugar beets	36	40	80	40	0
		50	40	0	0
		60	0	0	0
Irrigated	60	10	120	80	40
Spring-planted		20	80	40	0
Small grains[2]		30	40	0	0
		40	0	0	0
Onions	36	10	300	260	220
		20	260	220	180
		30	220	180	140
		40	180	140	100
		50	140	100	60
		60	100	60	20
		70	60	20	0
		80	20	0	0
		90	0	0	0
Field Corn	60	10	280	240	200
		20	240	200	160
		30	200	160	120
		40	160	120	80
		50	120	80	40
		60	80	40	0
		70	40	0	0

Sweet corn, reduce N recommended for field corn by 25 per cent

			Early or Short Season Crop[3]	Long Season Crop	Early or Short Season Crop[3]	Long Season Crop	Early or Short Season Crop[3]	Long Season Crop
Potatoes	36	10	200	300	160	200	120	160
		20	160	250	120	160	80	120
		30	120	225	80	120	40	80
		40	80	180	40	80	0	40
		50	60	150	0	40	0	0
		60	60	100	0	0	0	0
		70	60	60	0	0	0	0

[1] If stover from corn or straw from wheat is incorporated after September 1, add 40 to 80 lbs. N to the recommendation, depending upon the amount of residue and time of incorporation. Larger amounts of residue and later incorporation require more N. Apply N for the crop in the spring, not for the residue in the fall. (It is recommended that wheat not follow wheat in the rotation because of possible disease problems.)

[2] If too much nitrogen is available to the crop, lodging is likely to occur. These nitrogen rates may have to be reduced for some of the weaker strawed small grains. Where soil test values are high, lodging can occur, particularly following legumes, even where no N fertilizer is applied.

[3] Due to the short growing season, all potato crops in Central Oregon and Klamath County would be designated as "Short Season."

Interpretation of the Nitrate-N Soil Test

The soil test values for nitrate-N obtained from the OSU Soil Testing Laboratory are expressed in parts per million (ppm). The nitrate-N soil test values appearing on the Soil Test Report form and in the FG sheet are the total ppm nitrate-N from all soil layers sampled in the field. In order to estimate the number of pounds per acre of available nitrate-N, multiply the reported soil test value by a factor of 4.0. When the deepest soil layer sampled is less than 12" thick the factor used is somewhat less than 4.0.

Sample Calculations of Number of Pounds of Nitrate-N Per Acre Based on Soil Test Results

Example 1: Where soil depths sampled all equal 12 inches.

Soil Depth (Inches)	OSU Soil Test Value For Nitrate-N (ppm)	× Conversion Factor	= Estimated lbs/A of Nitrate-N
0-12	8	4	32
12-24	12	4	48
24-36	4	4	16
TOTAL			96

Example 2: Where deepest soil layer sampled is less than 12 inches.

Soil Depth (Inches)	OSU Soil Test Value For Nitrate-N (ppm)	× Conversion Factor	= Estimated lbs/A of Nitrate-N
0-12	8	4	32
12-24	12	4	48
24-32	4	2.7[1]	10.8
TOTAL			90.8

[1] The conversion factor equals:

$$\frac{\text{Depth of Soil Layer Sampled in Inches}}{12} \times 4 = \frac{8}{12} \times 4 = 2.7$$

Acknowledgment

The information contained in this publication is largely based on research conducted in the irrigated area of Central Washington and recommendations from Washington State University publication E. M. 3076 entitled "Interpretation of Soil Test Nitrogen for Irrigated Crops in Central Washington," by A. I. Dow, D. W. James, and C. E. Nelson.

Prepared by E. Hugh Gardner, Extension Soils Specialist, Oregon State University. Reviewed by a committee of Oregon Agricultural Experiment Station workers and County Extension Agents.

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