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Using the Nitrogen Mineralization Soil Test to Predict Spring Fertilizer N Rate

Soft White Winter Wheat Grown in Western Oregon

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Soft white winter wheat grown in western Oregon requires a spring application of nitrogen (N) fertilizer for optimum production. Determining the amount of N to apply has been a challenge for growers because wheat is produced in numerous rotations that provide varying amounts of N to the wheat crop. Inadequate N results in reduced yield. However, excess N causes lodging, higher-than-desired grain protein, and added expense.

Wheat obtains N from two sources: soil and fertilizer. Soil N is provided in available mineral form (nitrate or ammonium-N) and as mineralizable N (nitrogen that will become available during the growing season). Nitrate and ammonium-N supply only 5 to 15 percent of the total N requirement. Mineralizable soil N supplies 5 to 40 percent of the total N requirement. The remainder (40 to 70 percent) comes from N fertilizer.

Both available and mineralizable N can be measured to predict the spring fertilizer N rate for winter wheat using the "Nmin" soil test developed at Oregon State University. Research between 1993 and 2004 identified the relationship between the mineralizable N soil test and available N. In more than 30 research sites and grower fields, the test accurately predicted the spring fertilizer N requirement. The research was conducted across a range of soil types and crop rotations, and in fields using both conventional tillage and direct seeding to establish stands.

Using the mineralizable N soil test for irrigated winter wheat, spring wheat, or other crops is not recommended. *Current research, through January 2006, has calibrated the Nmin test only for use in western Oregon winter wheat. It is not intended for use with any other crop.*

Using the mineralizable nitrogen test (Nmin)

Taking a sample

The first step is to collect a composite soil sample from the 0- to 12-inch depth using a soil sampling tube. The sample should include a minimum of 20 soil cores representing the area to be fertilized. The best time to take soil samples is during the last 2 weeks of January.

January is the best time to sample for two reasons. First, the relationship between the Nmin test and wheat N uptake at this time is well correlated. Also, the Nmin test requires much more time than traditional soil tests. Sampling in January allows enough time for analysis of the soil sample (about 2 weeks) and calculation of fertilizer needs before application of N fertilizer at Feekes GS 5 (generally the end of February). Application of some spring N by Feekes GS 5 is critical since rapid N uptake begins at the next development stages. For more information about wheat N use, see Pacific Northwest Extension publication PNW 513, *Nitrogen Uptake and Utilization by Pacific Northwest Crops*.

Through more than 10 years of research, Neil Christensen, OSU soil scientist, developed the Nmin test for wheat, a method for accurately predicting the spring fertilizer N requirement.

After taking the sample, keep it cool until delivery to the laboratory. Request three analyses from the laboratory: (1) ammonium-N, (2) nitrate-N, and (3) mineralizable N. Be sure the laboratory you choose can provide all analyses. Not all laboratories offer a test for mineralizable N by anaerobic incubation. Request that analyses be expressed in parts per million (ppm) or milligrams per kilogram (mg kg^{-1}), not as pounds per acre (lb/a). For a list of analytical laboratories serving Oregon, see Extension publication EM 8677.

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Table 1. Recommended spring N fertilizer rates based on the Nmin soil test and extractable soil NH_4-N plus NO_3-N.

Nmin soil test (ppm or mg kg^{-1})	Soil test $NH_4 + NO_3$ (ppm or mg kg^{-1})			
	less than 10	10 to 15	16 to 20	more than 20
	N fertilizer rate (lb N/a)			
12	200	180	165	145
16	180	160	145	125
20	160	140	125	105
24	140	120	105	85
28	120	100	85	80
32	100	80	80	80
36+	80	80	80	80

Finding the spring N rate

With the three N analyses in hand, use Table 1 to select a spring N fertilizer application rate. The table recommends spring N rates of 80 to 200 lb N/a. Even when the Nmin test is high, a minimum amount of fertilizer N is needed for optimum wheat production. OSU research has shown that 80 lb N/a is the minimum prudent amount to apply (shaded portion of Table 1).

To find a spring N rate using Table 1, be certain the soil test results are in parts per million (ppm) or milligrams per kilogram (mg kg^{-1}). Begin with the Nmin soil test results. Values are found in the left-hand column of Table 1. Follow the Nmin column down until you find the Nmin soil test value closest to yours.

Next, add together your soil test NH_4-N and NO_3-N values. Then locate the column heading that contains the sum of these values. Move down the $NH_4 + NO_3$ column and to the right from your Nmin value. The number where the row and column intersect is the recommended spring N rate in pounds of N/acre.

In Table 1, Nmin test values increase by increments of 4 ppm, and spring N rates increase by increments of 20 lb/a. If your Nmin soil test value is between those in Table 1, adjust the recommended spring N application rate by 5 lb/a for each 1 ppm Nmin.

Example

Nmin test value = 20 ppm
NH_4-N + NO_3-N = 18 ppm
(6 ppm NH_4-N + 12 ppm NO_3-N)

In this example, the Nmin soil test (left-hand column) is 20 ppm. The sum of NH_4-N plus NO_3-N values is 18 ppm. Move down the column labeled “Nmin soil test” until you reach “20.” Now find the column labeled “16 to 20” at the top. The intersection of the Nmin row and the $NH_4 + NO_3$ column is 125. The recommended spring N fertilizer rate is 125 lb N/a.

Mineralizable N analysis

The analytical procedure for mineralizable N determination is very different from that used for other soil nutrient analyses; it involves incubating the sample for 7 days. A detailed procedure is available in Horneck et al. (see “For more information”).

For more information

Christensen, N.W. and M.E. Mellbye. 2006. Validation and recalibration of a soil test for mineralizable nitrogen. *Communications in Soil Science and Plant Analysis* (accepted for publication).

Hart, J.M. 2002 (revision). *A List of Analytical Laboratories Serving Oregon*. Oregon State University Extension Service publication EM 8677 (http://eesc.oregonstate.edu/agcomwebfile/edmat/html/em/em8677/em8677.html).

Sullivan, D.M., J.M. Hart, and N.W. Christensen. 1999. *Nitrogen Uptake and Utilization by Pacific Northwest Crops*. Oregon State University Extension Service publication PNW 513.

Horneck, D.A., J.M. Hart, K. Topper, and P. Koepsell. 1989. *Methods of Soil Analysis Used in the Soil Testing Laboratory at Oregon State University*. Oregon State University Agricultural Experiment Station publication SM 89:4.

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