FIRST OF A SERIES

Testing ... Testing: Nitrogen

One soil test lab says the field needs no nitrogen. Another recommends 230 pounds per acre.

Which one do you believe? It's often hard to tell in . . .

The never-never land of N

Editor's Note: Farmers may be wasting millions of dollars a year on nitrogen fertilizers because of the lack of a reliable nitrogen soil test, new Rodale Press research shows. Wide differences in the philosophies and scientific practices of many major soil test laboratories make the problem even worse. *Testing . . . Testing* will detail similar problems with phosphorous, potassium, lime and micronutrient soil tests in future issues of THE NEW FARM.

Concept and research:
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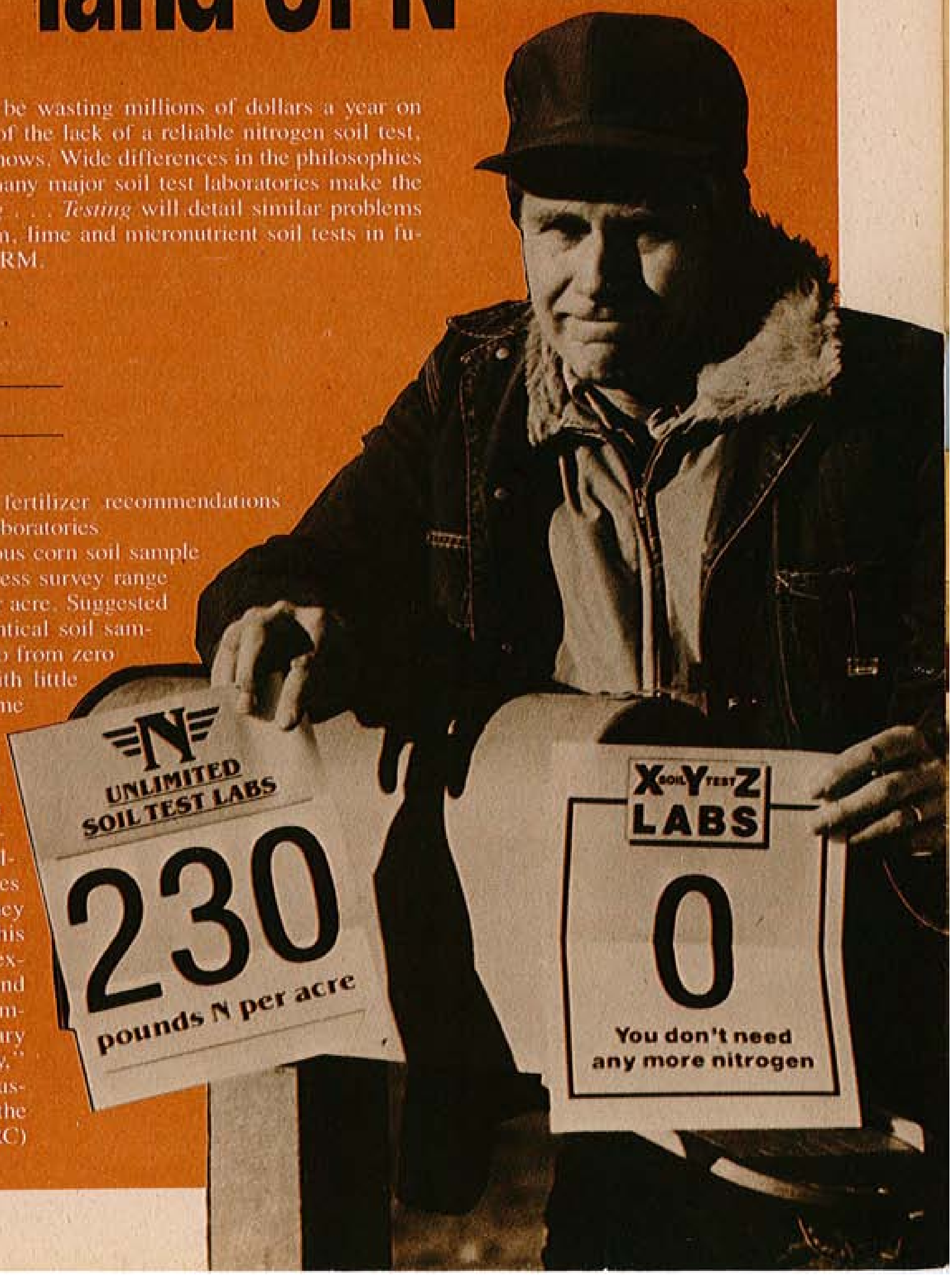


EMMAUS, Pa.—Nitrogen fertilizer recommendations from 69 major soil testing laboratories analyzing the same continuous corn soil sample in an anonymous Rodale Press survey range from zero to 230 pounds per acre. Suggested nitrogen rates based on identical soil samples from five other fields go from zero to 210 pounds per acre, with little regard for previous legume crops, cropping history and soil organic matter.

"A reliable nitrogen soil test is just not available. As a result, farmers are probably spending millions of dollars every year on heavy doses of nitrogen fertilizer that they don't really need. All this comes at a time when extremely low farm prices and high input costs make it impossible to justify unnecessary operating costs economically," says William C. Liebhardt, assistant research director at the Rodale Research Center (RRC) in nearby Kutztown.

"Practical soil testing people want soil analyses which are quick and inexpensive. But a quick, reliable, inexpensive nitrogen soil test simply has not been developed," adds Liebhardt. "Therefore, many labs use other means of estimating soil nitrogen release and nitrogen fertilizer recommendations."

The survey also found that:

*Only one-third of the labs responding to the survey use soil organic matter in estimating nitrogen released in the soil. Their measurements of soil organic matter vary as widely as their fertilizer recommendations.

*There is no standard procedure for measuring nitrogen placed in the soil by legumes. In fact, in the fertilizer recommendations of 19 labs, previous legume crops were totally ignored.

Two Midwestern labs that said no nitrogen was needed on the continuous corn field in the survey, recommend from 44 to 50 pounds of nitrogen per acre on first-year corn after two years of alfalfa.

*Most labs do not give credit for residual legume-fixed nitrogen after one year of a non-legume crop.

*While fertilizer recommendations vary widely from region to region because of differences in climate and soils, there is almost as much variation within a single state.

The Rodale soil test study was begun early last June when Liebhardt and Martin Culik, RRC agronomy research coordinator, took soil samples from six different fields in eastern Pennsylvania. They sent 84 sets of six samples each to commercial and university soil testing labs, which do an estimated 75 percent of the soil testing around the country. The samples were not identified as being from Rodale Press. (See *Testing . . . Testing: How We Did It,* Page 37.) The 1980–81–82 crop sequence for each of the six fields was: corn-corn-corn; alfalfa-alfalfa-corn; trees-trees-corn; corn-soybeans-corn; alfalfa-corn-corn; and alfalfa-corn-corn. The samples were accompanied by a request for fertilization recommendations for 125 bushel dryland corn on the 1982 corn crop in each field.

"Since most available nitrogen from the soil is a result of organic matter breakdown or decomposition, a test for organic matter is used to estimate soil nitrogen release," Liebhardt explains. "Each year, about 2 percent to 3 percent of the nitrogen in organic matter is made available through this process. Temperature, moisture and other factors determine the rate of nitrogen release.

"In our survey of soil testing labs, about one-third of the labs use the organic matter content to estimate nitrogen release. A few labs use the soil nitrate profile to estimate nitrogen availability, but most labs in the survey did not perform any nitrogen availability test.

"Those labs that do determine organic matter show considerable variation in the organic matter content of the same soil. In general, the assumption in using the organic matter approach is that the higher the organic matter content, the more nitrogen is released and less additional nitrogen is needed," he says.

"Our survey shows that this is not always the case, as the organic matter determinations by soil testing labs vary as widely as their fertilizer recommendations. As soil organic matter rates increase, fertilizer recommendations should decrease. But high organic matter levels in our study often resulted in high fertilizer recommendations," Liebhardt adds. "The woodlot that we said was to be cleared for first-year corn, for example, was higher than the other fields in organic matter. Yet the recommendations in general do not seem to take this into account to any extent."

For all six fields sampled, the most common recommendation was for from 121 to 150 pounds of nitrogen per acre. "It would appear that this is due to a practice of recommending one to 1.25 pounds of nitrogen per bushel of corn expected. In some cases, it is 1.5 pounds per bushel of corn expected," Liebhardt says.

"If this is the system used by a laboratory, then organic matter and legumes may be eliminted as a variable and nitrogen recommendations become simple mathematics for the laboratory," he says. "For the farmer, however, they become very expensive because homegrown or native nitrogen may not be a part of the process."

Of the 69 labs responding to the RRC survey, nitrogen recommendations for the continuous corn field ranged from zero to 230 pounds per acre. (A complete list of the labs' recommendations begins on Page 32) Slightly more than 40 percent of the labs suggest 121 to 150 pounds of nitrogen per acre. More than one-third recommend more than 150 pounds of nitrogen per acre, with about 25 percent at 120 pounds or less. "It is clear that nitrogen recommendations on this field are not uniform," Liebhardt says.

TABLE 1.

Same soil samples yield widely different nitrogen recommendations.

Field History or Rotation 1980 - '81 - '82	Nitrogen Fertilizer Recommended (lbs/A) low	high	average
corn - corn - corn	0	230	139
alfalfa - alfalfa - corn	0	210	105
trees - trees - corn	30	210	133
corn - soybeans - corn	35	210	131
alfalfa - corn - corn	0	210	136
alfalfa - corn - corn	0	210	135

[1]*data from 65 labs*

"The variations were even more pronounced in recommendations for first-year corn after two years of alfalfa," he adds. "Forty-five percent of the laboratories have equal or higher rates of recommended nitrogen for first-year corn after alfalfa, compared to continuous corn. In fact, two labs that recommended zero nitrogen on the continuous corn field said 44 to 50 pounds of nitrogen per acre were needed on the corn following alfalfa.

"However, unpublished research by Dr. Dale Baker of Penn State and Victor Wegrzyn (now director of the Coolidge Center in Topsfield, Mass.) in fields near the RRC shows no positive yield response to nitrogen fertilizer two years following alfalfa on some fields and none of other fields three years after alfalfa," Liebhardt says.

"Less than one in five labs allow 75 pounds or more of nitrogen per acre as a result of alfalfa preceding corn. Thirty-one of the labs lowered their recommendations for the alfalfa-alfalfa-corn field to varying degrees, but fully 19 of the labs made no change in their across-the-board recommendations for from 120 to 210 pounds of nitrogen per acre.

"On the average, previous legume crops are credited with only 25 to 30 pounds of nitrogen, which is terrible. These data show that many labs do not take into account the nitrogen in legumes in making their recommendations.

"Fertilizer recommendations for the field in the corn-soybean-corn rotation are also extremely variable. Corn-soybean growers ought to be able to take advantage of the nitrogen they receive from soybeans, but this is ignored by most of the labs," Liebhardt says.

"Corn following soybeans is treated much the same as continuous corn by most labs," he adds. "Some laboratories allow 30 to 40 pounds of nitrogen per acre credit for soybeans and others suggest a pound of nitrogen credit per bushel of soybeans produced.

"The labs are scared to death of nutrient deficiencies and hefty recommendations, some might say over-recommendations, are just built into the system. The goal of the farmer is to grow the maximum crop with minimum inputs, whereas the lab's approach is to make sure the farmer doesn't have a nutrient deficiency," Liebhardt says. "Well, anyone can guarantee no nutrient deficiency if they recommend lots of everything.

"In some respects, the objectives of the laboratory may not be compatible with the farmer's objectives and farmers should understand the basis of a laboratory's operation and approach," he adds.

Complicating matters, Liebhardt says, is the fact that the latest research data is not always reflected in soil test recommendations. The suggested rates sent back to RRC by Pennsylvania State University, for example, called for application of 100 pounds of nitrogen per acre on the alfalfa-alfalfa-corn field. But recent Penn State research by Dr. R. H. Fox shows that the first year after good (75 percent) alfalfa, 130 pounds of nitrogen per acre is carried over from the alfalfa. As a result, Penn State is reducing its recommended nitrogen rate from 100 pounds to 20 pounds per acre for an anticipated yield of 125 bushels of corn per acre.

If RRC staffers had not already known of the latest research, they, like many farmers, would have been left with recommendations much higher than Penn State now says are necessary.

When RRC personnel pointed out the discrepancy to the university, they received the following reply from Extension Agronomist Douglas Beegle:

"The problem is that current soil test kits do not have spaces to indicate the different categories for nitrogen recommendations, including the second year after alfalfa. The new kits being distributed to the county agents have these categories, but there are still many of the old kits arou and in use. In the mean time, have been trying to distribute a r gen recommendation table s farmers can change the recc dations themselves." A cop revised nitrogen rates was with Beegle's letter.

"If a comparison is ma all the nitrogen rates and Penn State figures, the to 90 percent of the l over-recommending r following alfalfa," "The new Penn tions were based studies where measured, der portant field r termining fe tions.

"Without the results v over-recomm average nitr our study w for corn follo sume, as Pe pounds per ac

TABLE 2.

Little attention paid to nitrogen fixation of legumes.

Recommended Nitrogen Rates on Corn Following Alfalfa vs. Corn Following Corn

	% of laboratories
equal or greater rate following alfalfa	45
25 pounds less	4
26–50 pounds less	23
51–75 pounds less	12
76–100 pounds less	12
101–125 pounds less	3
126+ pounds less	1

The 69 soil test labs returning fertilizer recommendations for 125 bushel dryland all received the same soil samples, but you'd never know it from their recommendations.

Laboratory	Corn Corn Corn	Alfalfa Alfalfa Corn	Trees Trees Corn	Corn Soybeans Corn	Alfalfa Corn Corn	Alfalfa Corn Corn	Average	Mean $/A for N[1]	Contribution from Alfalfa Lbs./A	Soil Testing Fee
Summary N Lbs./A										
A & L Agricultural Laboratories, Inc., Ft. Lauderdale, Fla.	150	120	150	130	160	150	143.3	21.49	30	$116.40
A & L Agricultural Laboratories, Inc., Fort Wayne, Ind.	145	145	135	140	140	140	140.8	21.12	0	44.40
A & L Agricultural Laboratories, Inc., Omaha, Neb.	35	30	55	85	95	85	64.2	9.63	5	156.00
A & L Agricultural Laboratories, Inc., Memphis, Tenn.	150	155	130	135	140	140	141.7	21.25	0	44.40
A & L Agricultural Laboratories, Inc., Lubbock, Texas	150	155	145	130	130	120	138.3	20.74	0	75.30
A & L Eastern Agricultural Laboratories, Inc., Richmond, Va.	150	100	135	140	130	140	132.5	19.87	50	116.40
Advanced Agriculture, Inc., DeMatte, Ind.	155	155	157	155	157	157	156.0	23.40	0	351.20
Agra Soil Service, Lena, Ill.	152	152	152	152	152	152	152.0	22.80	0	12.00
Agrico Chemical Company, Baltimore, Md.	156	90	121	146	82	69	110.7	16.60	66	*
University of Arkansas	140	140	140	140	140	140	140.0	21.00	0	*
Auburn University, Auburn, Ala.	120	120	120	120	120	120	120.0	18.00	0	18.00
Bio-Ag Laboratories, Chillicothe, Mo.	110	40	30	70	130	110	65.0	9.75	70	75.30
Brookside Research Laboratories, New Knoxville, Ohio	161	161	161	161	161	161	161.0	24.15	0	120.00
Clemson University	120	120	120	120	120	120	120.0	18.00	0	*
Colorado State University	Suggests a fall sample be taken.									60.00
University of Connecticut	210	210	210	210	210	210	210.0	31.50	0	12.00
Cook College-Rutgers University	147	106 (50)[2]	150	150 (85)[3]	150	150	142.2	21.33	41	48.00
Cornell University	100	15	100	95	15	15	56.7	8.50	85	21.00
The University of Delaware	150	150	150	150	150	150	150.0	22.50	0	12.00
Edwards Soil Service, Pontiac, Ill.	144	144	144	144	144	144	144.0	21.60	0	15.00
Enviro-Service, Inc., Scottsbluff, Neb.	0	50	45	80	100	100	62.5	9.37	0	108.00
Erickson Consulting Laboratory, Fremont, Neb.	90	30	95	105	75	75	78.3	11.74	60	30.00
Farm Clinic, West Lafayette, Inc.	168	112	162	162	158	158	153.3	22.99	56	30.00
Fayette County Farm Bureau, Vandalia, Ill.	125	125	125	125	125	125	125.0	18.75	0	12.00
University of Florida	Does not analyze out of state samples.									
University of Georgia	175	175	175	175	175	175	175.0	26.25	0	30.00
Harris Laboratories, Inc., Lincoln, Neb.	155	105	150	155	160	160	147.5	22.12	40	40.50
Inter-American Laboratories, Cozad, Neb.	125	75	105	125	125	125	113.3	16.99	50	81.00

International Minerals & Chemicals Corp. Terre Haute, Ind.	160	160	160	160	160	160	160.0	24.00	0	60.00
Iowa State University	Does not analyze out of state samples.									
Iowa Testing Laboratories, Inc., Eagle Grove, Iowa	150	150	150	150	150	150	150.0	22.50	0	37.08
Kansas State University	140	30	140	100	100	100	101.7	15.25	110	36.00
University of Kentucky	150	100	150	150	150	150	141.7	21.25	50	*
Louisiana State University	160	160	150	150	150	150	153.3	22.99	0	*
University of Maine	150	150	150	150	150	150	150.0	22.50	0	6.00
University of Maryland	120	20	120	120	120	120	103.3	15.49	100	24.00
University of Massachusetts	180	180	180	180	180	180	180.0	27.00	0	12.00
Michigan State University	150	90	150	120	150	150	135.0	20.20	60	24.00
University of Minnesota	150	50	150	167	150	150	119.5	17.92	100	90.00
Minnesota Valley Testing Labs, New Ulm, Minn.	187	147	187	167	187	187	177.0	26.55	40	21.00
Minnesota Valley Testing Labs, Nevada, Iowa	187	147	187	167	187	187	177.0	26.55	40	21.00
Mississippi State University	165	165	165	165	165	165	165.0	24.75	0	*
University of Missouri	115	65	115	85	115	115	101.7	15.25	50	24.00
Mowers Precision Counseling Service, Toulon, Ill.	163	125	163	128	163	163	150.8	22.62	38	33.00
University of Nebraska	130	40	130	130	130	130	115.0	17.25	90	36.00
University of New Hampshire	143	105	138	138	138	138	133.3	19.99	38	24.00
North Carolina State University	120	80	120	80	120	120	106.7	16.00	40	*
North Dakota State University[4]	110	90	110	90	110	110	103.3	15.49	20	12.25
Ohio State University	130	65	125	100	130	130	113.3	16.99	65	24.00
Oklahoma State University	99	113	107	108	125	134	114.3	17.14	0	36.00
Olsen's Agricultural Laboratory, McCook, Neb.	70	0	90	100	120	120	83.8	12.49	70	108.00
Pennsylvania State University	130	20	130	110	90	90	95.0	14.25	110	36.00
Purdue University	140	140	140	120	140	140	136.7	20.50	0	22.80
Randolph County Farm Bureau, Sparta, Ill.	150	150	150	150	150	150	150.0	22.50	0	15.00
University of Rhode Island	180	180	180	180	180	180	180.0	27.00	0	12.00
Shields Soil Service, Dewey, Ill.	144	95	144	144	144	144	135.8	20.37	49	12.00
South Dakota State University[5]	160	60	150	110	160	140	130.0	19.50	100	36.00
Spoon River F.S., Inc., Galesburg, Ill.	180	180	180	180	180	180	180.0	27.00	0	6.00
Symo-Laboratory, Inc., Millersburg, Ohio	120	63	120	90	120	120	105.5	15.82	57	30.00
University of Tennessee	150	150	150	150	150	150	150.0	22.50	0	6.00
Texas A&M University	180	140	180	180	180	180	173.3	25.99	40	42.00
Texas Soil Laboratory, Edinburg, Texas	60	60	35	35	60	35	47.5	7.12	0	93.00
Triple S Lab, Inc., Loveland, Colo.	110	110	80	60	90	110	93.3	13.99	0	120.00
Twin County Service Co., Murphysboro, Ill.	150	100	150	110	150	150	135.0	20.25	50	18.00
United States Testing Company, Memphis, Tenn.	140	110	140	120	140	140	131.7	19.75	30	14.40
USS Agri-Chemicals, Belmond, Iowa	140	60	140	140	140	140	126.7	19.00	80	*
University of Vermont	230	50	80	210	210	210	165.0	24.75	180	36.00
Virginia Polytechnic, Blacksburg, Va.	138	138	138	138	138	138	138.0	20.70	0	*
West Virginia University	150	110	150	150	150	150	143.3	21.49	40	*
Willmar Testing Laboratory, Willmar, Minn.	0	44	37	49	62	62	29.0	4.35	0	104.86
University of Wisconsin	160	80	160	120	140	140	133.3	19.99	80	18.00
Woods End Laboratory, Temple, Maine	90	0	30	50	0	0	28.3	4.24	90	91.80

[1] *Assumes nitrogen at 15 cents per pound.* * *Bills not received yet.* [2] *Soil testing sheet recommended 106 lbs. N/A however back side of test report suggests reducing nitrogen application 100 lbs. N/A for a 75 percent stand of alfalfa.* [3] *Soil testing sheet recommended 150 lbs. N/A however back side of test report suggests [illegible] nitrogen application 65 lbs. N/A for a soybean crop.* [4] *Suggests a fall nitrogen sample—recommendation may not be reliable.* [5] *Suggests a 2 foot sample be sent for nitrogen.*

average of 85 pounds of nitrogen in excess was recommended. At 15 cents per pound of nitrogen, the cost of the excess nitrogen is $12.75 per acre."

Just how well crops respond to nitrogen from alfalfa can be seen in tissue tests on the 1981 corn crop, the first corn crop of the two alfalfa-corn-corn fields in the RRC soil test survey. The nitrogen content of the ear leaf at silking was 2.73 percent in one field and 2.74 percent in the other. In research at Ohio State University, Dr. J. Benton Jones Jr., now chairman of the University of Georgia Horticulture Department, found the sufficient nitrogen level at that stage of corn to be 2.76 percent to 3.5 percent. "Plants (in the sufficient range) are normal in appearance and have adequate concentrations of this element for maximum yield," he wrote in the Soil Science Society of America's Special Publication No. 2, Plant Analysis Part II. Jones wrote that plants in the "low" nitrogen range—2.46 percent to 2.75 percent—"may be normal in appearance, but probably will be responsive to fertilization. . . ." The two RRC tissue tests were .01 percent and .02 percent below Jones' sufficiency level.

"For all practical purposes, these numbers are the same," Liebhardt says. "These two fields, which are managed by a commercial organic farmer, received no nitrogen and showed no nitrogen deficiency. This would seem to agree with those laboratories recommending little or no nitrogen in regard to the nitrogen requirement of corn following alfalfa."

Armed with such information and the amounts of nitrogen fixed by legumes (see Table 4), Liebhardt believes farmers are in the best position to accurately assess the nitrogen needs of their crops following legumes.

"After all, they know the nitrogen status of their crops better than anyone. You don't have to rely on somebody's fancy soil test report. You can do it yourself with the information we provide here," he says.

"Suppose a farmer has two alfalfa fields which will be plowed prior to corn. One is a three-year stand in excellent condition, the other a four-year stand which is only about 30 percent to 40 percent alfalfa. For the excellent field, the few labs that give credit to alfalfa estimate it fixes 60 to 150 pounds of nitrogen per acre. The average is about 100 pounds per acre. That is probably a safe figure, as is probably the higher rate of 125 to 150 pounds per acre in most cases. But that is a judgment that farmer can make because of his knowledge of the situation.

"The other field presents a different problem. Some labs rate this quite high in regard to nitrogen release. Others almost ignore it as a nitrogen source. Here, again, is a place where the farmer can make a decision better than anyone else.

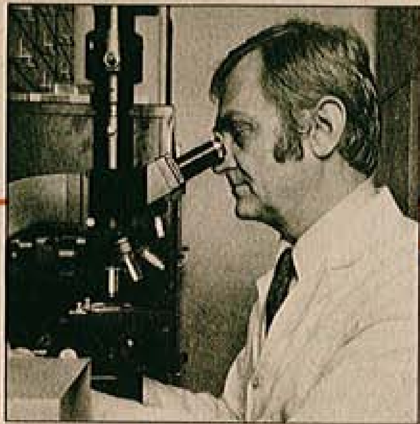
"If the first crop of corn grows well with little or no added nitrogen, most likely sufficient amounts of nitrogen are being released by the alfalfa. In addition, corn stalks will release extra available nitrogen with alfalfa residue present. This source of nitrogen will last longer than synthetic nitrogen, which, despite its tendency for leaching, can contribute nitrogen a second year. If soluble fertilizer can carry over, complex organic nitrogen certainly will have substantial amounts of nitrogen carried over from the first to the second corn crop. It's just common sense,"

TABLE 3.

Measurements of organic matter vary almost as much as the labs' fertilizer recommendations.[1]

% Organic Matter	Corn Corn Corn	Alfalfa Alfalfa Corn	Trees Trees Corn	Corn Soybeans Corn	Alfalfa Corn Corn	Alfalfa Corn Corn
	% Laboratories					
0–0.50	0	4	0	0	4	0
0.50–1.0	4	0	4	0	0	4
1.01–1.50	0	4	0	4	0	0
1.51–2.00	27	36	0	4	14	4
2.01–2.50	41	41	4	18	41	9
2.51–3.00	14	4	50	45	27	36
3.01–3.50	9	9	9	9	4	32
3.51+	4	0	32	18	9	14

[1]*Averages from 22 laboratories.*



Liebhardt says.

Location of a lab also plays a big part in its fertilizer recommendations because of differences in soils, crops and climate. The labs in the RRC study were selected because they are located east of the Rocky Mountains where corn is a common crop.

"In making a comparison of soil testing labs, it is easier and more meaningful to compare labs within a region, as crops, climate and soils are more similar," Liebhardt observes. "Soils in the Northeast are

TABLE 4.

How different labs estimate legume-fixed nitrogen levels in making nitrogen fertilizer recommendations.

Laboratory	% Alfalfa	Grass	Lbs. N from legumes per acre. Year: One	Two	Three
Cornell University	50+		125–150	50% of year 1	25% of year 1
	25–50		100–125		
	1–25		75–100		
Kansas State University	80–100		120–140	50% of year 1	—
University of Nebraska	good		80–100	—	—
	40–60		50	—	—
	40		0	—	—
Iowa State University	50–100		140	30 lbs. if field in legumes 2 years	—
	25–50		100	20 lbs. if in legume 1 year	—
	0–20		20	—	—
Olsen Ag Lab McCook, Neb.	60+		80–100	—	—
	40–60		40–80	—	—
	0–40		0–40	—	—
South Dakota State University	50+		100	50% of year 1	25% of year 1
	25–50		50		
	20		0		
Erickson Consulting Freemont, Neb.			60	30	—
Woods End Temple, Maine			80	—	—
University of Wisconsin	60–100		80	—	—
	20–60		40	—	—
	0–20		20	—	—
Pennsylvania State University	50+		130	60	
	25–50 medium alfalfa		100		
	25 poor alfalfa		60		
Rutgers	75		100	—	—
	50		75	—	—
	25		50	—	—

	Crops other than Alfalfa - Grass
South Dakota State University	Soybeans, reduce nitrogen rate one pound of nitrogen per bushel of soybeans produced. For alfalfa, red clover or sweet clover, allow 50 pounds of nitrogen per ton.
Iowa State University	40 pounds of nitrogen per acre of soybeans.
Kansas State University	Reduce nitrogen one pound per bushel of soybeans.
University of Nebraska	Values for clover are one-half those of alfalfa.
North Carolina State University	Peanuts and soybeans—reduce nitrogen 40 pounds per acre for a good crop and 20 pounds for a lesser crop.
Woods End	Soybeans—reduce nitrogen by 40 pounds per acre.

Rutgers	% Stand 75	50	25
	Lbs. N from legumes per acre.		
Ladino Clover	60	40	20
Crimson or Red Clover	50	35	15
Hairy Vetch	60	40	20
Soybeans			
Tops and Roots	50	25	15
Grain Harvest Residue	15	0	0

far different than those of the Midwest or the Southeast. In many of the Western states, soil samples in the autumn are taken to a depth of two to six feet and the nitrate in the soil profile is used as a means of estimating nitrogen availability. This procedure would not work in the wetter areas of the country because nitrate leaches rather easily under wet conditions.

"A regional approach to soil testing has the advantage that labs are giving recommendations in areas they are familiar with. It makes little sense to send soil samples half way across the country when local, regional labs are available, yet this often happens," he adds.

But even when dealing with labs in a single region or state, fertilizer recommendations can and do vary drastically. In the RRC study, for example, the seven labs in Nebraska recommend from zero to 155 pounds of nitrogen per acre on the continuous corn field. Their suggested rates on the five other fields differ by 75 to 105 pounds per acre.

"Many things are apparent from this study on nitrogen. In general, nitrogen fertilizer recommendations would appear to be quite excessive by most laboratories. The lack of field response data appears to be a major problem. In many instances, laboratories simply do not have the field response data they need to make their recommendations," Liebhardt says.

"A reliable nitrogen test is just not available. Some laboratories use organic matter, but even this does not appear to be satisfactory when considering the variations in the organic matter analyses and the resulting nitrogen recommendations. Some of the drier areas of the country use nitrate in the soil profile. In these areas, this may be satisfactory. But in wetter areas, nitrates in the soil profile will not work.

"In the case of nitrogen, it appears that any test which could work, such as soil incubation to determine the nitrogen available through mineralization, should be considered. Cropping history certainly is important, yet, by and large, it is ignored by laboratories. Those few labs that do use cropping history certainly generate different nitrogen recommendations than those that do not," Liebhardt adds. "Farmers should take this into account, as cropping history is certainly important with respect to nitrogen."

With such variations in nitrogen recommendations, the logical question is 'Why soil test?' Maybe the old agronomy professor was right after all when he said, "Soil testing is like grinding up a cow to test her milk."

Liebhardt doesn't think so. Despite the differing recommendations in the RRC study, he maintains that soil testing can be a helpful tool in developing a soil fertility program—when used in conjunction with plant tissue analysis, test strips, personal observations of crops, common sense and double checking recommendations with local labs or those with field calibration or crop response data for a farmer's particular area.

"By broadening their soil fertility indicators and management practices, farmers can become more self-reliant and break the cultural habit of high inputs," Liebhardt says.

Although it's more expensive (about $10 to $15 per sample) Liebhardt believes double checking soil tests with plant tissue analysis gives farmers a more complete picture of their crops' nutritional status. The core from a conventional soil probe, for example, is only about one inch in diameter. Taking 20 such samples from a 20-acre field reveals the status of only about 20 square inches of earth. Corn roots, however, draw nutrients from about a five foot radius. Testing the tissue from 20 plants would show the nutrient uptake from roughly 400 square feet of the same 20-acre field. Unlike nitrogen soil testing, the necessary nutrient levels in plants are well established.

With soil tests, Liebhardt says, "We have a very narrow view of what the soil has to release. The plant itself is able to tell you what it's able to take up and what it's not. If the plant's OK and the soil test says you need something, I'd really question the soil test.

"Tissue testing," he adds, "gives a much more representative sample of the field. With a little fine tuning, farmers can eliminate much of the guesswork and interpret soil tests with more certainty about what their crops really need and what they don't need." □

Next issue: Phosphorus.

Testing... Testing: HOW WE DID IT

KUTZTOWN, Pa.—The letters, handwritten on ruled notebook paper, came from a "farm manager" in a crossroads town in the heart of Pennsylvania Dutch Country.

"Enclosed are six soil samples which I would like analyzed for next year's crops," they all began. "All the fields will be planted to corn next year. We can grow 125 bushels of corn per acre in a normal year. The field numbers are on the bag.

"Field 1 was corn the past 2 years. No. 2 is a good field of alfalfa. No. 3 is small trees and shrubs which will be cleared. Field 58 was corn last year and soybeans this year. Fields 64 and 68 were alfalfa last year and corn this."

Just two simple paragraphs each. The 84 letters went to commercial

Culik, and Liebhardt

and university soil testing laboratories around the country. The labs do an estimated 75 percent of U.S. soil testing. They gave no hint that the letter writer had anything except next year's crops on his mind.

But there were no crops, no farm to manage. The man's name had been signed by as many as six different hands. He was no farmer, but the husband of a secretary at the Rodale Research Center (RRC) near Kutztown.

"On a rainy day, we just sat down and had about five or six people writing letters," explains Dr. William C. Liebhardt, assistant RRC research director.

The letter writing was one of the middle steps of a new RRC research project that first began late last winter while Ralph Nader was touring the center. Liebhardt, then a soil specialist teaching at the University of Delaware, was at the RRC to, in part, explain his preliminary work on the fact that fertilizer recommendations based on the same soil sample vary drastically, depending on the lab doing the analysis. Liebhardt says he had noted the difference for years, while working for chemical and other agricultural companies from the Midwest to Honduras. But he didn't follow up on them until last year when he had three UD students in his soil fertility class send the same soil samples to two different labs.

One sample went to the UD lab, which recommended 120 to 150 pounds of nitrogen per acre for 100 to 125 bushel corn. After analyzing the same soil, Harris Laboratories Inc., Lincoln, Neb., recommended not only 145 pounds of nitrogen per acre, but half a ton of lime, 95 pounds of potash, 15 pounds of magnesium, six pounds of zinc, zero to three pounds of manganese and 1.5 pounds of boron.

"I wanted the students to be exposed to the real life world, instead of the nice prose in the textbooks," Liebhardt recalls.

Liebhardt created something of a stir in the fertilizer industry last year when he challenged the popular theory that a specific ratio of calcium, magnesium and potassium is necessary for maximum soil productivity. Liebhardt said a 10-year study at the UD Agricultural Experiment Station showed that farmers, at least those in the poorly buffered, sandy coastal plains, were applying unnecessary nutrients by following recommendations based on the theory. The extra nutrients sometimes have no affect on crops, but other times they actually reduce yields, he said. Either way, Liebhardt stressed, farmers are wasting money by applying unneeded nutrients.

Liebhardt joined the RRC staff last June and developed a research plan to study the varying recommendations more fully. He selected five commercial fields and a woodlot for the RRC study because of their cropping history and other nutrient considerations. The continuous corn field had a low pH, the alfalfa-alfalfa-corn field a high pH. The trees-trees-corn field on the original Rodale Press Experimental Organic Farm near Emmaus was thought to be low in phosphorous. P and K were high in the corn-soybean-corn field. The first alfalfa-corn-corn field was extremely low in K, while the second such field had normal nutrition.

Liebhardt and Martin Culik, RRC agronomy research coordinator, then went to each of the fields with a plastic garbage can and a shovel. They filled each can with soil dug from a depth of six to eight inches. The cans full of dirt were taken back to the center where each sample was screened and thoroughly mixed.

Individual samples were then placed in labeled plastic bags. A collection of six samples, one from each field, went into a cardboard box along with one of the mass produced letters and was sent off to one of the labs.

"Samples were sent out before the Fourth of July and then it was just a matter of waiting for them to come back," Liebhardt says. Some analyses came back with recommendations within two to three weeks, but others arrived in early October.

"We were not trying to be sneaky, but we wanted the samples treated as if they had come from any farmer," Liebhardt adds. "We did not want anyone to know they came from Rodale Press because that might have raised a red flag. We did not want preferential treatment, but treatment as if they were anyone else's samples." □

WOODS END LABORATORY

Soil Report

Number
2104

Bob Schrader
RD #1411
Fleetwood, PA 19522

Date	July 20, 1981
Sample	#1
Date Sampled	June 1981

Previous Use Corn **Planned Use** Corn

Soil pH		Organic Matter %	2.4	Texture	Clay loam
In water	5.2	Cation Exchange Cap., meq/100 g	12.4		
In soil soln.	4.8				

HUMUS CHROMATOGRAM **Estimated Humus %** 1.4 **Humus Stability** Moderately high

Current Stability Expected? no, it is more stable than expected. This infers that organic matter is not accumulating significantly, as it normally would at such a low pH.

Nutrient Anions in Lb/A

Nitrogen Annual Release		desired level	130
		level estimated	50-70 L
Phosphorus	Available	desired level	56
		level found	70 M
	Reserve	desired level	130
		level found	140 M

Exchangeable Cations in Lb/A

			% Sat.
Calcium	desired level	3200	35
	level found	1700	ML
Magnesium	desired level	330	5
	level found	150	ML
Potassium	desired level	280	3
	level found	310	M
Exchangeable Acidity, meq/100 g		7.0	57 H

Summary of nutrient balance

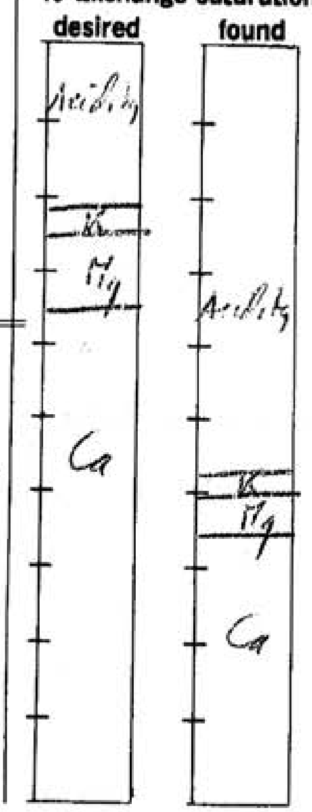
nitrogen - phosphorus: nitrogen low

calcium - magnesium - potassium: Ca & Mg low, but may be satisfactory for corn

anions - cations: fair

Most likely nutrient problem nitrogen

% Exchange saturation



Laboratory recommendations

Manure, 20-25 tons/A

Dolomitic limestone, 1 ton/A, followed next year by calcitic limestone, 1 ton/A; or dolomitic limestone, 2 tons/A

WOODS END LABORATORY

Soil Report

Number
2105

Bob Schrader
RD #1411
Fleetwood, PA 19522

Date July 20, 1981
Sample #2
Date Sampled June 1981

Previous Use Alfalfa Planned Use Corn

Soil pH	In water	6.5	Organic Matter %	2.5	Texture Clay loam
	In soil soln.	6.1	Cation Exchange Cap., meq/100 g	10.0	

HUMUS CHROMATOGRAM Estimated Humus % 1.5 Humus Stability Moderately high

Current Stability Expected? yes, it is reasonable at the current pH and organic content.

Nutrient Anions in Lb/A				Exchangeable Cations in Lb/A			% Sat.
Nitrogen Annual Release		desired level	130	Calcium	desired level	2600	60
		level estimated	120-160 M		level found	2400	M
Phosphorus	Available	desired level	56	Magnesium	desired level	260	12
		level found	24 ML		level found	290	M
	Reserve	desired level	130	Potassium	desired level	280	4
		level found	80 ML		level found	300	M
				Exchangeable Acidity, meq/100 g		2.4	24 M

Summary of nutrient balance

nitrogen - phosphorus phosphorus low

calcium - magnesium - potassium good

anions - cations fair

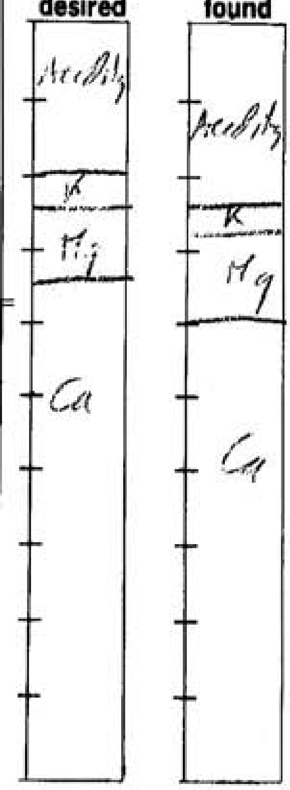
Most likely nutrient problem Phosphorus

Laboratory recommendations

Rock phosphate, 1 ton/A; or super phosphate, 520 lb/A; or triple phosphate, 250 lb/A

% Exchange saturation

desired found



WOODS END LABORATORY

Soil Report

Number
2106

Bob Schrader
RD #1411
Fleetwood, PA 19522

Date	July 20, 1981
Sample	#3
Date Sampled	June 1981

Previous Use none **Planned Use** Corn

Soil pH					
Soil pH	In water	6.9	Organic Matter %	5.0	Texture: Clay loam
	In soil soln.	6.5	Cation Exchange Cap., meq/100 g	11.3	

HUMUS CHROMATOGRAM Estimated Humus % 3.2 Humus Stability H

Current Stability Expected? yes

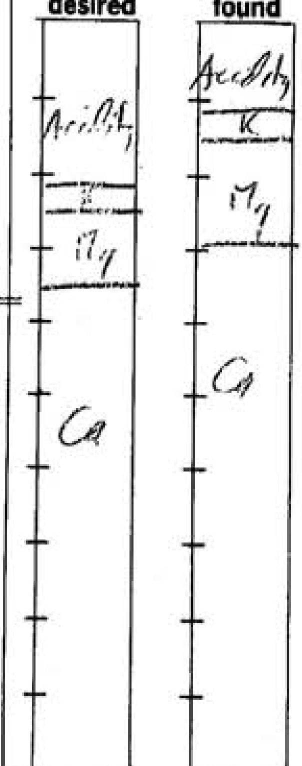
Nutrient Anions in Lb/A				Exchangeable Cations in Lb/A			% Sat.
Nitrogen Annual Release		desired level	130	Calcium	desired level	2900	71
		level estimated	100–140 M		level found	3200	M
Phosphorus	Available	desired level	56	Magnesium	desired level	300	15
		level found	22 ML		level found	400	M
	Reserve	desired level	130	Potassium	desired level	280	3
		level found	290 M		level found	250	M
				Exchangeable Acidity, meq/100 g		1.2	11 M

Summary of nutrient balance

- nitrogen - phosphorus: phosphorus low
- calcium - magnesium - potassium: good
- anions - cations: fair

Most likely nutrient problem phosphorus

% Exchange saturation (desired / found)



Laboratory recommendations

Manure, 5-10 tons/A

Superphosphate (optional), 520 lb/A, or triple phosphate (optional), 250 lb/A

WOODS END LABORATORY

Soil Report

Number
2107

Bob Schrader RD #1411 Fleetwood, PA 19522	Date	July 20, 1981
	Sample	#58
	Date Sampled	June 1981

Previous Use corn & soybeans **Planned Use** Corn

Soil pH	In water 6.5	Organic Matter %	4.6	Texture	Clay loam
	In soil soln. 6.0	Cation Exchange Cap., meq/100 g	13.4		

HUMUS CHROMATOGRAM Estimated Humus % 2.8 Humus Stability Moderately high

Current Stability Expected? yes

Nutrient Anions in Lb/A			
Nitrogen Annual Release		desired level	130
		level estimated	80-120 ML
Phosphorus	Available	desired level	56
		level found	137 M
	Reserve	desired level	130
		level found	440 M

Exchangeable Cations in Lb/A			% Sat.
Calcium	desired level	3500	61
	level found	3200	M
Magnesium	desired level	350	11
	level found	360	M
Potassium	desired level	280	3
	level found	310	M
Exchangeable Acidity, meq/100 g		3.4	25 M

Summary of nutrient balance

nitrogen - phosphorus fair

calcium - magnesium - potassium good

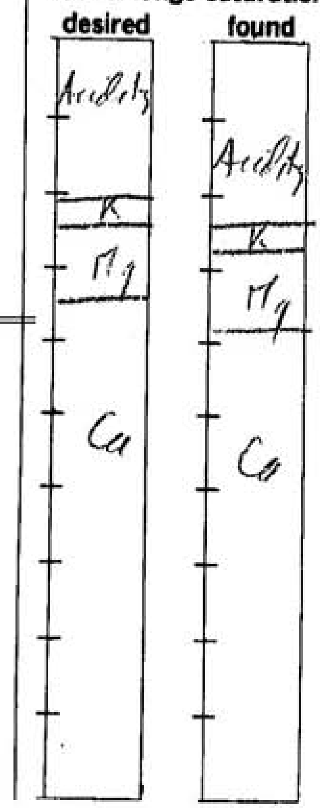
anions - cations good

Most likely nutrient problem nitrogen

Laboratory recommendations

Manure, 7-12 tons/A

% Exchange saturation



WOODS END LABORATORY

Soil Report

Number
2108

Bob Schrader RD #1411 Fleetwood, PA 19522	Date July 20, 1981 Sample #64 Date Sampled June 1981

Previous Use	Alfalfa, corn	Planned Use	Corn

Soil pH	In water 7.0	Organic Matter %	4.1	Texture	Clay loam
	In soil soln. 6.7	Cation Exchange Cap., meq/100 g	10.1		

HUMUS CHROMATOGRAM		Estimated Humus %	2.5	Humus Stability	Moderately high
Current Stability Expected?	yes				

Nutrient Anions in Lb/A				Exchangeable Cations in Lb/A			% Sat.
Nitrogen Annual Release		desired level	130	Calcium	desired level	2600	71
		level estimated	110-150 M		level found	2900	M
Phosphorus	Available	desired level	56	Magnesium	desired level	270	19
		level found	102 M		level found	450	MH
	Reserve	desired level	130	Potassium	desired level	280	0.7
		level found	320 M		level found	60	L
				Exchangeable Acidity, meq/100 g		1.0	10 ML

Summary of nutrient balance

nitrogen - phosphorus: good

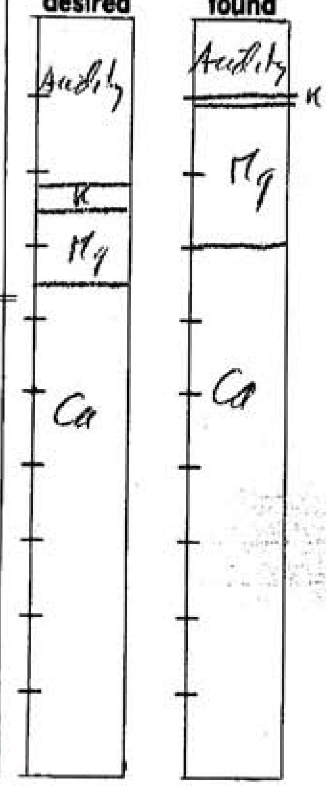
calcium - magnesium - potassium: potassium low

anions - cations: good, except potassium/nitrogen low

Most likely nutrient problem: potassium

% Exchange saturation

desired / found



Laboratory recommendations

Granite dust, 3 tons/A; or potassium sulfate, 240 lb/A/yr for 3 year; or muriate of potash, 200 lb/A/yr for 3 years; or manure, 10-15 tons/A

WOODS END LABORATORY

Soil Report

Number
2109

Bob Schrader RD #1411 Fleetwood, PA 19522	Date	July 20, 1981
	Sample	#68
	Date Sampled	June 1981

Previous Use	Alfalfa, corn	Planned Use	Corn

Soil pH	In water 7.0	Organic Matter %	5.4	Texture	Clay loam
	In soil soln. 6.6	Cation Exchange Cap., meq/100 g	11.8		

HUMUS CHROMATOGRAM	Estimated Humus % 3.2	Humus Stability	Moderately high
Current Stability Expected?	yes		

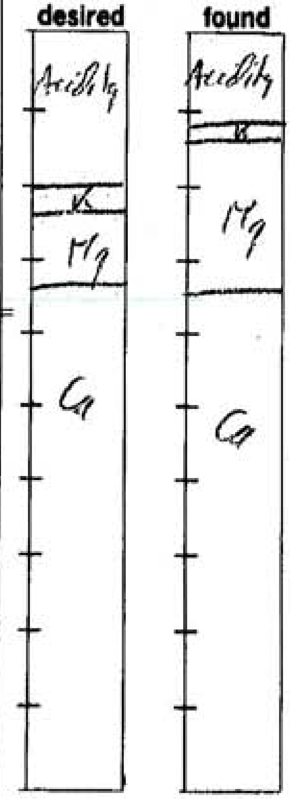
Nutrient Anions in Lb/A				Exchangeable Cations in Lb/A			% Sat.
Nitrogen Annual Release		desired level	130	Calcium	desired level	3100	64
		level estimated	140-180 M		level found	3000	M
Phosphorus	Available	desired level	56	Magnesium	desired level	310	21
		level found	145 M		level found	590	MH
	Reserve	desired level	130	Potassium	desired level	280	2
		level found	470 M		level found	180	ML
				Exchangeable Acidity, meq/100 g		1.6	14 M

Summary of nutrient balance

nitrogen - phosphorus	good
calcium - magnesium - potassium	potassium reserve is down
anions - cations	good
Most likely nutrient problem	potassium

% Exchange saturation

desired found



Laboratory recommendations

Granite dust, 2 tons/A; or potassium sulfate, 160 lb/A/yr for 3 years; or muriate of potash, 130 lb/A/yr for 3 years; or manure, 10-15 tons/A

SOIL HEALTH SERIES

Using Soil Tests to Measure and Predict Soil Quality and Nitrogen Mineralization

Summary Report

Woods End Laboratories, Inc

Woods End Laboratories INCORPORATED

Introduction

- Mineralization of soil-stored organic-N **(ON)** from soil organic matter (**SOM**) provides available **N** to crops.
- Most labs do *not* measure it.
- Most of **N** in compost is **ON**, of *unknown availability,* and is also *not* measured.
- Lab methods to predict mineralization of N+P from **SOM** are neither accurate nor cost effective for routine use.

ISSUE

As a result, soil fertilization with N and P may be unnecessary or excessive;

Contributions from organic sources

(SOM, compost and manure) may be under-estimated.

Environmental relevance

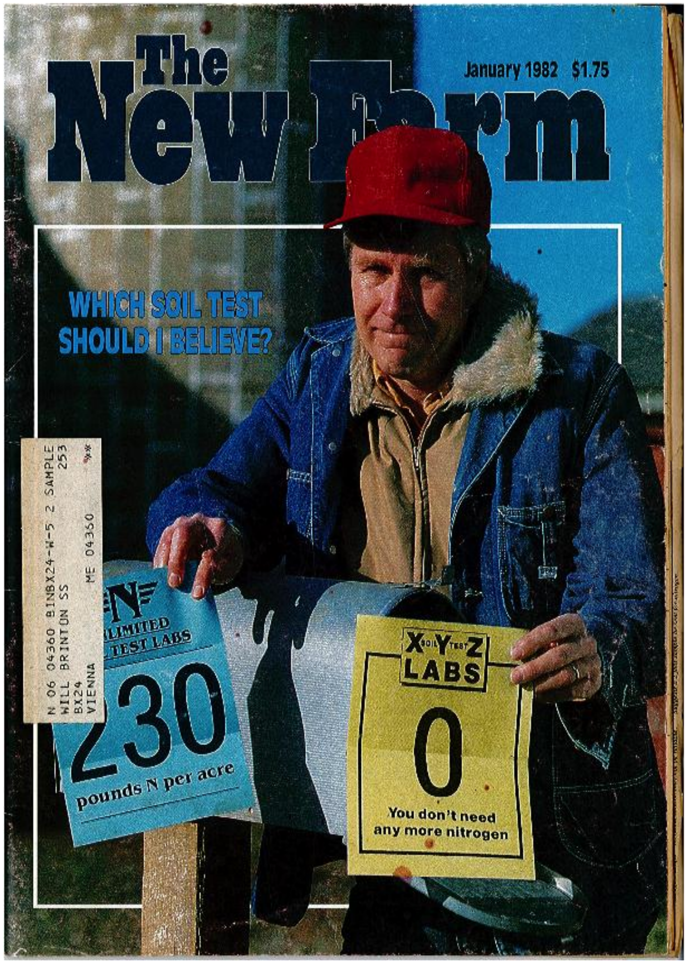
"*Excess nutrients absorb through the soil into groundwater supplies, contaminating local waterways and drinking supplies*"

Chesapeake Bay Program 2010

"Nitrate problems will likely worsen for decades. For more than half a century, nitrate from fertilizer and animal waste have infiltrated into … aquifers. Most nitrate in drinking water wells today was applied to the surface decades ago."

Addressing Nitrate in California's Drinking Water. California Nitrate Project, Implementation of Senate Bill X21, 2012

Root of Problem: Soil Test Rates



69 soil tests labs each received 6 soil samples of varying crop history (including prior legumes) and asked for corn requirements*

- The most frequent recommendation was "120-150 lb/a N" regardless of soil condition;
- Only 15 labs adjusted N-recommendations to apparent soil potential
- Only 3 labs pin-pointed high N-potential soils and suggested "little or no N needed"
- The range of N-recommended for a fertile high N-potential soil was 0 to 210 lb/a N
- The mean N cost per acre for surveyed labs ranged from $4.24 (Woods End) to $31.65/a (a difference of $9,200‡ for N for entire farm)

**Survey director William C. Liebhardt. Ph.D., UC Davis; formerly Rodale Institute, PA*

‡ In 2009 dollars this is $21,184

Soil Test Survey

Soil nutrient levels, fertilizer recommendations, and how labs accounted for prior crops, were reviewed

FIRST OF A SERIES

Testing ... Testing: Nitrogen

One soil test lab says the field needs no nitrogen. Another recommends 230 pounds per acre.

Which one do you believe? It's often hard to tell in . . .

The never-never land of N

Editor's Note: Farmers may be wasting millions of dollars a year on nitrogen fertilizers because of the lack of a reliable nitrogen soil test, new Rodale Press research shows. Wide differences in the philosophies and scientific practices of many major soil test laboratories make the problem even worse. *Testing . . . Testing* will detail similar problems with phosphorous, potassium, lime and micronutrient soil tests in future issues of THE NEW FARM.

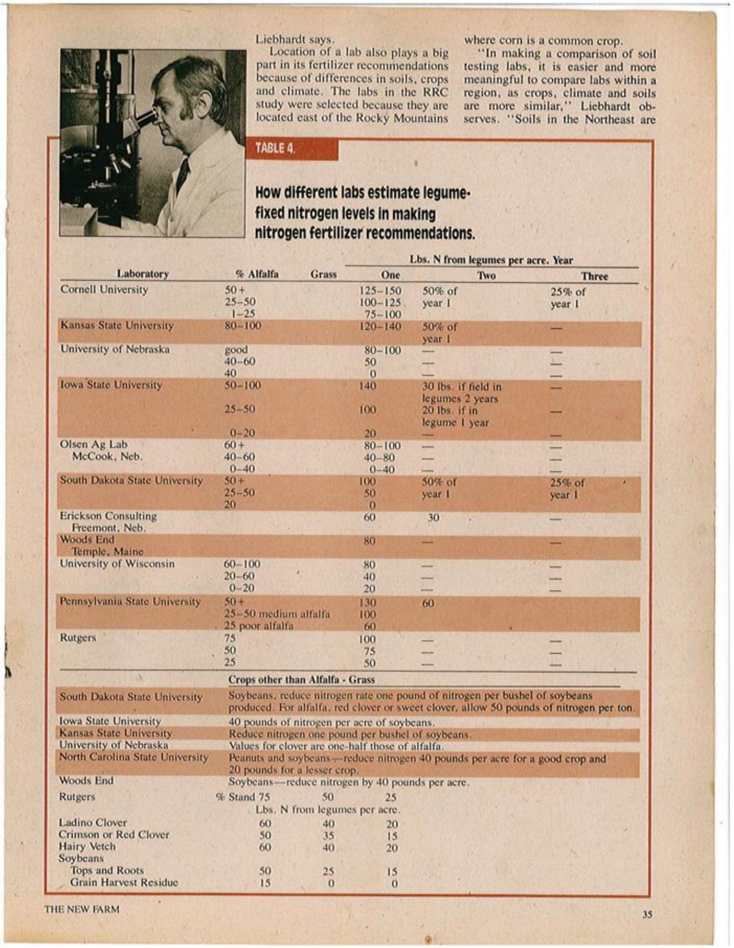
Concept and research:
William C. Liebhardt, Ph.D.,
assisted by Martin Culik

GEORGE DeVAULT

© THE NEW FARM, 1981

EMMAUS, Pa.—Nitrogen fertilizer recommendations from 69 major soil testing laboratories analyzing the same continuous corn soil sample in an anonymous Rodale Press survey range from zero to 230 pounds per acre. Suggested nitrogen rates based on identical soil samples from five other fields go from zero to 210 pounds per acre, with little regard for previous legume crops, cropping history and soil organic matter.

"A reliable nitrogen soil test is just not available. As a result, farmers are probably spending millions of dollars every year on heavy doses of nitrogen fertilizer that they don't really need. All this comes at a time when extremely low farm prices and high input costs make it impossible to justify unnecessary operating costs economically," says William C. Liebhardt, assistant research director at the Rodale Research Center (RRC) in nearby Kutztown.



Liebhardt says.

Location of a lab also plays a big part in its fertilizer recommendations because of differences in soils, crops and climate. The labs in the RRC study were selected because they are located east of the Rocky Mountains where corn is a common crop.

"In making a comparison of soil testing labs, it is easier and more meaningful to compare labs within a region, as crops, climate and soils are more similar," Liebhardt observes. "Soils in the Northeast are

TABLE 4.

How different labs estimate legume-fixed nitrogen levels in making nitrogen fertilizer recommendations.

Laboratory	% Alfalfa	Grass	Lbs. N from legumes per acre. Year: One	Two	Three
Cornell University	50+		125–150	50% of year 1	25% of year 1
	25–50		100–125		
	1–25		75–100		
Kansas State University	80–100		120–140	50% of year 1	—
University of Nebraska	good		80–100	—	—
	40–60		50	—	—
	40		0	—	—
Iowa State University	50–100		140	30 lbs. if field in legumes 2 years	—
	25–50		100	20 lbs. if in legume 1 year	—
	0–20		20	—	—
Olsen Ag Lab McCook, Neb.	60+		80–100	—	—
	40–60		40–80	—	—
	0–40		0–40	—	—
South Dakota State University	50+		100	50% of year 1	25% of year 1
	25–50		50		
	20		0		
Erickson Consulting Freemont, Neb.			60	30	—
Woods End Temple, Maine			80	—	—
University of Wisconsin	60–100		80	—	—
	20–60		40	—	—
	0–20		20	—	—
Pennsylvania State University	50+		130	60	
	25–50 medium alfalfa		100		
	25 poor alfalfa		60		
Rutgers	75		100	—	—
	50		75	—	—
	25		50	—	—

Crops other than Alfalfa - Grass

Laboratory	
South Dakota State University	Soybeans, reduce nitrogen rate one pound of nitrogen per bushel of soybeans produced. For alfalfa, red clover or sweet clover, allow 50 pounds of nitrogen per ton.
Iowa State University	40 pounds of nitrogen per acre of soybeans.
Kansas State University	Reduce nitrogen one pound per bushel of soybeans.
University of Nebraska	Values for clover are one-half those of alfalfa.
North Carolina State University	Peanuts and soybeans—reduce nitrogen 40 pounds per acre for a good crop and 20 pounds for a lesser crop.
Woods End	Soybeans—reduce nitrogen by 40 pounds per acre.

Rutgers	% Stand 75	50	25
	Lbs. N from legumes per acre.		
Ladino Clover	60	40	20
Crimson or Red Clover	50	35	15
Hairy Vetch	60	40	20
Soybeans			
Tops and Roots	50	25	15
Grain Harvest Residue	15	0	0

THE NEW FARM 35

Nitrogen Recommendations: 1982 Soil Survey of 6 soils

1982 Survey: 69 Soil Lab Testing Recommendations						
ROTATION	**F1 Corn Corn Corn**	**F2 Alfalfa Alfalfa Corn**	**F3 Trees Trees Corn**	**F58 Corn Soy Corn**	**F64 Alfalfa Corn Corn**	**F68 Alfalfa Corn Corn**
Average N-rate recommended	**138**	**105**	**129**	**129**	**136**	**135**
Median Rate of all labs	150	110	140	138	140	140
Deviation of N-rate	40	51	43	38	38	39
Minimum N Recommended	0	0	10	28	0	0
Maximum N recommended	230	210	210	210	210	210
Woods End Lab Rate	**90**	**0**	**30**	**50**	**0**	**0**
tested Soil Organic Matter level	2.4	2.5	5.0	4.6	4.1	5.4
Humus stability	high	medium	medium	Med-high	Med-High	Med-high
Reported N-release potential	**50-70**	**120-160**	**100-140**	**80-120**	**110-150**	**140-180**
Humus est. from TLC separation	1.4	1.5	3.2	2.8	2.5	3.2
N-release calculated at 1.5% of OM	72	75	150	138	123	162
N-release calc at 2.5 % of humus	70	75	160	140	125	160

*** 1982 data calculated by Woods End**

Break Out of N-rates by Soil Lab Groups vs. Woods End Laboratories*

LABS INVOLVED in SURVEY	69	**N-recommendation for Continuous Corn**				
		Average	deviation	**Lo-rate**	**Hi-Rate**	**Median**
State labs	26	147	28	99	230	150
Private Labs	43	128	47	0	187	148
Compare to: Woods End Lab	1	**90**				
		N-recommendation for Alfalfa-Alfalfa-Corn				
		Average	deviation	Lo-rate	Hi-Rate	Median
State labs	26	106	52	15	210	108
Private Labs	43	103	50	0	180	110
Compare to: Woods End Lab	1	**0**				
		N-contribution to current crop from two-years alfalfa				
		mean	deviation	lo	high	median
State labs	26	41	47	0	180	40
Private Labs	43	29	30	0	90	30
Compare to: Woods End Lab	1	**90**				

*** 1982 data calculated based on original reports**

Soil Survey Phosphorus

1982 Survey: Phosphorus Soil Testing Recommendations

ROTATION	F1 Corn Corn Corn	F2 Alfalfa Alfalfa Corn	F3 Trees Trees Corn	F58 Corn Soy Corn	F64 Alfalfa Corn Corn	F68 Alfalfa Corn Corn
Average P-rate recommended	**38**	**67**	**34**	**18**	**23**	**20**
Median Rate of all labs	40	63	40	0	19	0
Deviation of P-rate	33	40	28	24	27	27
Minimum P Recommended	0	0	0	0	0	0
Maximum P recommended	150	189	110	100	100	110
Woods End Lab recommended rate	**0**	**112**	**112**	**0**	**0**	**0**
Soil Bray P1 found, lb/a (Woods End)	**70**	**21**	**22**	**137**	**102**	**145**
Soil Bray P2 found, lb/a	140	80	290	440	320	470

*** 1982 data calculated based on original reports**

Soil Survey Phosphorus

LABS INVOLVED in SURVEY	**70**	**P-recommendation for Continuous Corn field F1**				
		Average	*deviation*	*Lo-rate*	*Hi-Rate*	*Median*
State labs	26	43	41	0	150	40
Private Labs	44	32	26	0	90	39
Compare to: Woods End Lab	1	0				
		P-recommendation for Alfalfa-Alfalfa-Corn				
		Average	*deviation*	*Lo-rate*	*Hi-Rate*	*Median*
State labs	26	65	41	0	150	60
Private Labs	44	70	41	0	189	67.5
Compare to: Woods End Lab	1	112				

*** 1982 data calculated from original reports**

Soil Survey Potassium

Lab Survey: Soil Testing Recommendations							
ROTATION	F1 Corn Corn Corn	F2 Alfalfa Alfalfa Corn	F3 Trees Trees Corn	F58 Corn Soy Corn	F64 Alfalfa Corn Corn	F68 Alfalfa Corn Corn	Average
Average K-rate recommended	33	42	69	59	152	109	77
Median Rate of all labs	30	33	60	45	140	98	72
Deviation of K-rate	36	49	52	51	83	74	45
Minimum K Recommended	0	0	0	0	40	0	13
Maximum K recommended	160	270	211	245	595	531	259
Woods End Labs	0	0	30	0	220	78	55
K found lb/a	**310**	**300**	**250**	**310**	**60**	**180**	**235**
K as % CEC	3	4	3	3	0.7	2	2.6

*** 1982 data calculated from original reports**

Since the 1982 survey ….

- Soil test certification programs were launched after 1992 and proficiency test programs (NAPT) started in 1998;
- Many labs now routinely account for prior cropping and manuring to adjust (downwards) recommended rates;
- Nutrient budgeting now widely practiced which acts to put boundaries on farm-level fertilizer rates;
- Testing may now include use sidedress NO_3 test (PSNT), 7day-N-min or ISNT (hydrolyzable amino-N) to adjust N-rates for mineralizable nitrogen;
- Solvita® test now widely available (~30 commercial labs)

1982 ERA

WOODS END LABORATORY

Soil Report

Number
2105

Bob Schrader
RD #1411
Fleetwood, PA 19522

Date	July 20, 1981
Sample	#2
Date Sampled	June 1981

Previous Use	Alfalfa	Planned Use	Corn

Soil pH	In water	6.5	Organic Matter %	2.5	Texture	Clay loam
	In soil soln.	6.1	Cation Exchange Cap., meq/100 g	10.0		

HUMUS CHROMATOGRAM Estimated Humus % 1.5 Humus Stability Moderately high

Current Stability Expected? yes, it is reasonable at the current pH and organic content.

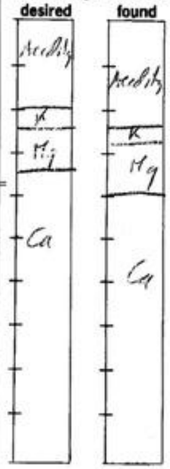
Nutrient Anions in Lb/A				Exchangeable Cations in Lb/A			% Sat.
Nitrogen Annual Release		desired level	130	Calcium	desired level	2600	60
		level estimated	120-160 M		level found	2400	M
Phosphorus	Available	desired level	56	Magnesium	desired level	260	12
		level found	21 ML		level found	290	M
	Reserve	desired level	130	Potassium	desired level	280	4
		level found	80 ML		level found	300	M
				Exchangeable Acidity, meq/100 g		2.4	24 M

Summary of nutrient balance

- nitrogen - phosphorus: phosphorus low
- calcium - magnesium - potassium: good
- anions - cations: fair

Most likely nutrient problem: Phosphorus

% Exchange saturation (desired / found)



Laboratory recommendations

Rock phosphate, 1 ton/A; or super phosphate, 520 lb/A; or triple phosphate, 250 lb/A

CURRENT

Woods End Laboratories INCORPORATED

"Innovative Soil Testing .... since 1975"

Awardees: "Most Meaningful Soil Test" International Competition Holland

290 Belgrade Road
P.O. Box 297
Mount Vernon, ME 04352
207 293 2457
for more information: lab@woodsend.org

SOIL QUALITY TEST RESULTS

For: **SAMPLE REPORT**
New Elm Farm
Street
City

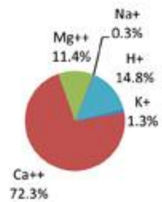
Account : 2370
Sample Identification : 8310.4
Lab ID Soil: Field 5

Sample Received: 3/12/2012
Report Date: 3/27/2012

Test Parameter Examined		UNITS reported	RESULTS	R
Soil pH		-	6.91	M
Buffer pH*		-	6.69	-
Salinity		dS/M	0.16	VL
Chloride		mg / kg	32.54	
Phosphate (P')	P	mg / kg	29	L
Potassium	K+	mg / kg	104	L
Calcium	Ca++	mg / kg	3,022	M
Magnesium	Mg++	mg / kg	285	MH
Sodium	Na+	mg / kg	18	VL
Hydrogen	H+	mg / kg	3	
CEC		me / 100g	20.9	MH
Organic Matter*		%	10.3	H
WSOC		ppm	463.1	M
Aggregate Stability		% vol	31	M
NH_4-N		ppm	1.7	
Nitrate-N		ppm	3.5	
OrgC:N			12.0	

Biological Parameter	RESULTS	R
Solvita $CO_{2,\ ppm}$	69.4	MH
N-release, lb/a	56	MH
WSN ppm	43.9	L
Season Available-N, lb/a	99	

Cation Relationships



R = Ranking or rating
L=Low, M= Moderate MH= Medium High (good) H= Excessive
All nutrients in modified Morgan extract, OM by LOI @
CEC= (Ca+Mg+K+Na+H) as meq/100g
Buffer pH is Woodruff for Exchangeable Hydrogen
Test Methods: *Soil Test Procedures for the NorthEastern US * Bulletin #493, Univ of Delaware*

B:\lab-files\lab-reports\SAMPLE_SOIL.xls

Accounting for N-release today

- Consider full soil test results.
- Include soluble NO_3, NH_4 and WSN*
- Measure Solvita CO_2-burst
- Potential Available N is: Solvita + (Sol-N)
- Compare PMN to realistic N-required for crop in that climate and soil-type.

Selected Benchmarks

1. Liebhardt, W (1982) **Testing, Testing: The Never-Never Land of Nitrogen**. *New Farm Vol 4: #1-3*
2. Brinton W (1985) **N-response of Maize to Fresh and Composted Manure**. *Biol. Agr. Hort. 3:55-64*
3. Doran, J T Kettler, M Tsivou (1997) **Field and Laboratory Solvita Soil Test Evaluation** USDA-ARS, Univ Nebraska, Lincoln
4. Haney R, W. Brinton, E Evans. (2007) **Soil CO_2 Respiration: Comparison of Chemical Titration, IRGA and Solvita Gel System**. *Renew. Ag Food Systems 23:1–6*.
5. Haney, R & W. Brinton (2008) **Estimating Soil C, N, and P mineralization from short-term CO_2 respiration.** *Comm. Soil Sci Plant Analysis, 39: 2706–2720*
6. *Harter et al. (2012)* **Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater**. *Center for Watershed Sciences, University of California, Davis. 78 p. http://groundwaternitrate.ucdavis.edu.*

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