UNIVERSITY OF WYOMING

Cooperative Extension Service
Department of Plant, Soil, and Insect Sciences
College of Agriculture

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INTERPRETING UNIVERSITY OF WYOMING SOIL TEST REPORTS

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Your soil test report (Figure 1) can provide valuable information about your soil conditions and help you become a more successful producer. To make the best use of the soil resource, you need to understand how to interpret soil test results. The soil properties covered in your soil test report interact in a complicated system. Physical and chemical properties both affect a plant's ability to grow and produce seed, forage, roots, or fruit. The fertilizer recommendations given on your soil test report (Figure 2) are only guidelines based on the soil test results and information provided on the sample questionnaire when the soil sample was submitted. There may be other adjustments that should be made based on factors beyond the control or knowledge of the University of Wyoming Soil Testing Laboratory. For crops requiring nitrogen fertilization, soil sampling and testing should be conducted annually. For pH, organic matter, phosphate, potassium, iron, and zinc, sampling every two-three years is usually adequate. These soil properties do not change rapidly unless radical changes in fertilization or management programs have occurred. Also, keep in mind that a soil test is only as reliable as the sample that was submitted. Consult your UW extension educator for more information.

Soil Testing Variables

1 Soil Texture: Sand, loamy sand, and sandy loam soils are light-textured soils. Light soils are characterized by high water infiltration rates, low water-holding capacity, and low nutrient-holding capacity. Light soils will require more frequent irrigation than medium and heavy soils. Light soils are more susceptible to leaching of soluble nutrients such as nitrate and sulfate.

Loam, silt loam, silt, and sandy clay loam soils are medium-textured soils. These soils usually have favorable physical properties for plant growth. They generally hold the most **plant-available** water of the three textural groups, and usually have adequate nutrient-holding capacity.

Clay loam, silty clay loam, sandy clay, silty clay, and clay are heavy-textured soils. Heavy soils are often characterized by slow water-infiltration rates, high water-holding capacity, and high nutrient-holding capacity. Heavy soils may require more phosphorus than light soils, but are less prone to nutrient leaching losses and require less frequent irrigation than lighter soils.

Soil-texture extremes usually create management problems for the producer. Soil texture is not easily modified. Problems with soil physical properties resulting from soil texture are more easily handled by careful management and building up soil organic matter than by trying to change soil texture. The UW Soil Testing Laboratory estimates soil texture by the feel method. When a more accurate determination is needed, a particle size analysis can be performed for an additional charge.

2 Organic Matter: Organic matter is important in maintaining the soil's desirable chemical and physical properties. Organic matter improves water-holding capacity (especially plant-available water), permeability, aeration, and resistance to compaction. Organic matter increases the soil's ability to adsorb and hold plant nutrients, and releases nutrients as it decomposes. Herbicide rates can be affected by soil organic matter levels. Consult the product label for specific guidelines.

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Figure 1. Sample soil test report.

UNIVERSITY OF WYOMING

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John Doe
123 Main
Somewhere, WY

09–Mar–94
Sample ID 1
Laboratory ID 2456
Natrona County

SOIL TEST DATA

RESULTS FOR STANDARD TESTS		RESULTS FOR EXTRA TESTS IF REQUESTED	
Soil Texture	Sandy clay loam	Potassium ppm	248.0
% Organic Matter	2.5	Iron ppm	5.2
Lime Estimate	High	Zinc ppm	1.5
Soil Paste pH	8.1	Subsoil Nitrate ppm	****
Soil Dilution pH	****		
Salt Estimate dS/m	1.3		
Phosphate–P, ppm	8.0		
Nitrate–N, ppm	6.0		

Dilution pH is only run if the paste pH is 8.5 or higher
Salt Estimate = Electrical Conductivity. If salts are high for a crop it will be noted on the recommendation page.
**** Means test was not requested.

These samples are accepted and reported on an as received basis by a non–regulatory agency. There are no warranties, expressed or implied, of merchantability or fitness of purpose, or otherwise of the results or of the original sampled material and in any event, liability for damages, regardless of the form of action will not exceed the price paid for the Service. In no event will the state of Wyoming or the University of Wyoming, its Trustees, Officers, employees or agents be liable for any consequential damages. These results cannot be used in publications without the expressed permission of the University of Wyoming. If you have any questions, please contact your University of Wyoming Extension Agent.

Reported by,

Organic matter is also important in maintaining necessary biological activity. Most Wyoming soils have less than 2 percent organic matter and will benefit from practices that encourage organic matter accumulations.

3 Lime Estimate: Lime is a source of calcium, an essential plant nutrient, but high-lime soils (lime content >2 percent), which are common in Wyoming, require more phosphorus and possibly more potassium than other soils. High-lime soils are usually fertile soils. Some plant nutritional imbalances, such as micronutrient deficiencies, may be observed on high-lime soils because of excess calcium and high pH.

4 Soil Paste pH: pH is a measure of the acidity or alkalinity of a soil. A pH above 7.0 is alkaline, a pH below 7.0 is acidic. The pH of most Wyoming soils is between 7.0 and 8.5. The optimum pH for most crop species will fall between about 6.0 and 7.0 (slightly acid), but many plants will actually tolerate a wide range in soil pH. Perhaps the most common problem observed with soil-pH extremes is nutritional imbalance. pH can also affect herbicide activity. Very acid soils can be improved by liming, but alkaline soils resulting from high lime are not easily changed. The UW Soil Testing Laboratory measures soil pH on a saturated paste of your soil.

5 Soil Dilution pH: If your paste pH value is 8.5 or above, the laboratory does a "dilution pH" to obtain a qualitative estimate of the amount of sodium in your soil. In addition to high pH, soils high in sodium often have undesirable physical properties such as slow permeability and poor aeration. Sodium-affected soils are not easily reclaimed, but may benefit from organic matter and sulfur or gypsum addition. Consult your UW extension educator if sodium problems are suspected. You may need some additional tests to determine the exact nature of the problem.

6 Salt Estimate: Salt buildup, or soil salinity, is common in arid and semi-arid regions and is often caused by poor-quality irrigation water and/or poor soil drainage. Soil salinity may usually be corrected by improving soil drainage and leaching. Small grains, sugarbeets, and range grass species are generally moderately tolerant to tolerant of salts. Corn, alfalfa, and other legumes are generally sensitive or moderately sensitive to salts. Table 1 gives general guidelines for crop-tolerance selection with varying salinity levels. Sensitivity to salts can vary with growth stage. Many species are more sensitive to salts during germination and emergence than during vegetative growth. Contact your UW extension agent for specific crop salinity tolerances. The UW Soil Testing Laboratory estimates salinity on an extract of the saturated soil paste.

Table 1. Relative crop tolerance of soil salinity.

Relative crop salinity tolerance rating	Salt estimate at which yield loss begins
Sensitive	< 1.3
Moderately sensitive	1.3 - 3.0
Moderately tolerant	3.0 - 6.0
Tolerant	6.0 - 10.0
Unsuited for most crops (unless reduced yield is acceptable)	> 10.0

From Ayers, R.S., and D.W. Westcot. 1985. Water quality for agriculture. FAO Irrigation and Drainage Paper no. 29.

7 Phosphate-P: Phosphorus (P) is essential for all plants and is often applied as fertilizer because much of the total P in the soil is in forms unavailable to plants. Phosphate application is often recommended when soil P has not been built up by overfertilization. Phosphorus is considered immobile in soil, does not leach readily in the soil, and does not usually constitute an environmental hazard when soil erosion is prevented. Soil-test phosphate is an index of phosphorus availability and should not be considered a measure of the actual amount available to plants. Phosphate levels above 22 parts per million (ppm) are considered sufficient for adequate growth of most species. Phosphorus recommendations are adjusted for soil texture and are increased on high-lime soils. The UW Soil Testing Laboratory uses sodium bicarbonate extraction (Olsen method) for phosphate determination.

8 Nitrate-N: Nitrogen (N) is usually the nutrient required in the greatest quantities by most plants. Legumes, such as alfalfa and clovers, will not usually benefit from N additions if conditions are favorable for N fixation. The nitrate form of N is available to plants. In determining fertilizer requirements, soil nitrate-N (in lbs/acre) can be subtracted from plant food requirements. Excessive N applications can be detrimental to both the crop and the environment. Excessive N applications reduce the quality of crops such as sugar beets and malting barley. Because nitrate is easily leached from the soil, excess nitrate can end up in the ground water. Nitrogen recommendations are adjusted for soil organic matter, past manure applications, cropping history, and several other factors as necessary when such information is available. The UW Soil Testing Laboratory uses a water extraction for nitrate determination.

9 Potassium: Potassium (K) is usually required by plants in relatively large amounts. Potassium levels above 120 ppm are considered to be adequate for most species. Potassium is considered immobile in soils and does not usually constitute an environmental hazard. Most Wyoming soils have large K reserves and K fertilizer applications are usually not necessary in Wyoming. However, some K deficiencies have been observed in alfalfa in some parts of the state. Potassium analysis is recommended if the soil has not been tested for K recently and alfalfa is the intended crop. Potassium analyses are not run as a standard test at UW, but can be requested for an additional fee. UW uses the ammonium bicarbonate-DTPA extraction for K determination.

10 Iron and Zinc: Iron (Fe) and zinc (Zn) are often abundant in Wyoming soils, but are in forms unavailable to the plant. Deficiencies of these nutrients may be observed in susceptible plants growing in high-lime soils. Corn, dry beans, and sugarbeets have high Zn requirements, and dry beans are somewhat susceptible to iron deficiencies. Zinc may be applied to soil, but soil applications of Fe are often ineffective. When Fe and/or Zn deficiencies are confirmed, foliar treatments may be beneficial. Consult your UW extension educator for more information. Iron and Zn analyses are not run as a standard test at UW, but can be requested for an additional fee. UW uses the ammonium bicarbonate-DTPA extraction for Fe and Zn determination.

Calculating Your Fertilizer Needs:

Fertilizers are rated by percentage of available nutrient. Diammonium phosphate with a grade of 18-46-0 would contain 18 percent nitrogen (N), 46 percent phosphorus (P_2O_5), and 0 percent potassium (K_2O). One ton of 16-20-0-24S would contain 16 percent (320 pounds) nitrogen, 20 percent (400 pounds) phosphorus (P_2O_5), no potassium, and 24 percent (480 pounds) sulfur.

To calculate the amount of fertilizer you need:

$$\frac{\text{(lbs nutrient needed)} \times 100}{\text{\% nutrient in fertilizer}} = \text{lbs of fertilizer needed}$$

For example, if the fertilizer grade was 34-0-0 (34% N, 0% P_2O_5, 0% K_2O), and you needed 150 pounds N/acre, you would apply 441 lbs of fertilizer (34-0-0):

$$\frac{\text{(150 lbs N/acre)} \times 100}{34} = \text{441 lbs of fertilizer (34-0-0)/acre}$$

John Doe		
09-Mar-94	Sample ID	1
Natrona County	Laboratory ID	2456

FERTILITY RECOMMENDATIONS

Desired Vegetation	**Grasses, general**	
****	****	
Yield Goal	**4 Tons**	
Irrigation Type	**Flood**	
NITROGEN(N)	162	LBS/ACRE
PHOSPHOROUS(P205)	48	LBS/ACRE
POTASSIUM(K20)	-248	LBS/ACRE
IRON(FE)	0	LBS/ACRE
ZINC(ZN)	0	LBS/ACRE

*******Means test was not run and no recommendations can be made.**

Fertilizer recommendations preceded by a minus sign indicate a surplus of that nutrient. If practical yield goal is different from that shown, adjust application of **N,** P205 and K20 by 40, **15** and 40 lb for each ton change.

Figure 2. Sample fertility recomendations.

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