Soil Test Interpretations

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A soil test can be an important management tool in developing an efficient soil fertility program, as well as monitoring a field for potential soil and water management problems. A soil test provides basic information on the nutrient supplying capacity of the soil. However, a test is not reliable if the soil sample is taken incorrectly or is improperly handled after collection. If you need help taking a soil sample properly, see your county Extension agent for publications on the proper soil sampling methods, and for a soil sampling kit.

Because analytical techniques vary among laboratories, the number values reported may vary from lab to lab. Numbers used by each have specific meanings for the laboratory. The interpretations discussed here are for the Soil, Plant and Water Testing Lab at New Mexico State University.

Fertilizer and soil management recommendations shown on the soil test report are based on the soil test and information provided on the information sheet which accompanies the soil sample to the lab. Items on the information sheet include cropping history, previous yields, fertilizer used, depth of soil and water table, water quality, and irrigation practices. Additional comments made on the information sheet can include general appearance of the crop, yield practices, or problems that may have a bearing on the crop. Fertilization requirements can vary with overall crop management program. Complete and accurate information is essential to get a fertilizer recommendation that will ensure the maximum yield for the least cost.

Individual Soil Tests

The following classifications are used for the standard soil test conducted by NMSU Soil, Plant and Water Testing Lab. Analyses for other factors are available upon request and require additional fees. Except for pH, the classifications are categorized as very low, low, moderate, high, and very high. For fertility factors (N, P, K, micronutrients) very low and low classifications indicate a high probability for obtaining a fertilizer response; moderate classifications indicate a fertilizer response may or may not occur; high and very high classifications indicate a fertilizer response is not likely to occur.

pH. Most crops will grow satisfactorily on soils with a pH ranging from 6.2 to 8.3. Crops susceptible to iron and zinc deficiencies may be affected at pH levels above 7.5.

Soils with a pH of 8.3 or higher usually have a high sodium content. Applications of sulfuric acid usually lower the pH for only a short period due to the high buffering capacity of the soils.

pH	*Classification*
> 8.5	strongly alkaline
7.9–8.5	moderately alkaline
7.3–7.9	slightly alkaline
6.7–7.3	neutral
6.2–6.7	slightly acid
5.6–6.2	moderately acid
3.0–5.6	strongly acid

Salts, Electrical Conductivity (E.C. x 10^3). When the electrical conductivity is less than 2, few salinity problems are evident. Problems may become evident in highly sensitive crops when the E.C. x 10^3 is from 2 to 4, although problems are usually minor. When the E.C. x 10^3 is from 4 to 8, problems usually are evident. When the E.C. x 10^3 is greater than 8, crops with moderate salt tolerance will usually show signs of reduced growth, foliage burn or chlorosis. Leaching can decrease the salinity hazard if soil permeability is adequate. Tables 1 and 2 list the salt tolerances of some crops and ornamental plants.

E.C. x 10^3	*Classification*
< 2	very low
2–4	low
4–8	moderate
8–16	high
> 16	very high

Table 1. Relative salt tolerance of selected crops, in order of decreasing tolerance within each group.

Good salt tolerance	Moderate salt tolerance	Poor salt tolerance
	Field Crops	
barley (grain)	rye (grain)	vetch
sugar beet	wheat (grain)	
rape	oats (grain)	
cotton	alfalfa	
	sorghum (grain)	
	corn (grain)	
	foxtail millet	
	sunflower	
	Forage Crops	
alkali sacaton	white sweetclover	white Dutch clover
saltgrass	yellow sweetclover	meadow foxtail
bermudagrass	perennial ryegrass	alsike clover
Canada wild rye	mountain bromegrass	red clover
western wheatgrass	barley (hay)	ladino clover
	birdsfoot trefoil	
	strawberry clover	
	dallisgrass	
	sudangrass	
	hubam clover	
	alfalfa	
	tall fescue	
	rye (hay)	
	wheat (hay)	
	oats (hay)	
	Truck Crops	
garden beet	tomato	radish
kale	broccoli	spinach
asparagus	cabbage	celery
	cauliflower	green beans
	lettuce	
	potatoes (White Rose)	
	sweetcorn	
	carrot	
	peas	
	onion	
	squash	
	canteloupe	
	cucumber	
	Fruit and Nut Crops	
pistachio	grape	pear
palm		apple
		prune
		plum
		apricot
		peach
		strawberry
		pecan

Table 2. Tolerance of selected ornamental plants to soil salinity.

Tolerance and range at which plants are affected	Ornamental plant
Extremely sensitive E.C. x 10^3 = < 2	Southern yew Glossy abelia Photinia Rose Chinese holly Star jasmine Pyrenees cotoneaster
Sensitive E.C. x 10^3 = 2–3 or 4	Laurustinus Chinese hibiscus Heavenly bamboo Japanese pittosporoum Algerian ivy
Moderatley tolerant E.C. x 10^3 = 4–5 or 6	Spreading juniper Pyracantha Thorny elaeagnus Oriental arborvitae Indian hawthorn Japanese black pine Japanese boxwood Yellow sage
Moderately tolerant (con't)	Glossy privet
Tolerant E.C. x 10^3 = 6–8	Aleppo pine European fan palm Rosemary Spindle tree Blue dracaena Oleander
Most tolerant E.C. x 10^3 = 8–10	Croceum iceplant Purple iceplant Rosea iceplant White iceplant Ceniza Bougainvillea Natal plum

Exchangeable Sodium. Sodium problems arise when the exchangeable sodium is 20% or more. High sodium soils (sodic soils) can be reclaimed if the sodium can be replaced by another element, usually calcium. Applications of gypsum, elemental sulfur, or sulfuric acid have successfully reclaimed calcareous soils which are high in sodium, providing good permeability is present. Notations are made on the soil test report if either a sodium or salinity hazard exists. Table 3 lists the exchangeable sodium tolerances of some crops.

Sodium %	*Classification*
< 10	low
10–20	moderate
20–30	high
> 30	very high

Table 3. Tolerance of various crops to exchangeable-sodium-percentage.

Tolerance to ESP[1] and range at which crop is affected	Growth response under field conditions
Extremely sensitive (ESP = 2–10) Deciduous fruits Nuts Citrus Avocado	Sodium toxicity symptoms
Sensitive (ESP = 10–20) Beans	Stunted growth at low ESP values even though the physical condition of the soil may be good
Moderately tolerant (ESP = 20–40) Clover Oats Tall fescue Rice Dallisgrass	Stunted growth due to both nutritional factors and adverse soil conditions
Tolerant (ESP = 40–60) Wheat Cotton Alfalfa Barley Tomatoes Beets	Stunted growth usually due to adverse physical condition of soil
Most tolerant (ESP = more than 60) Crested wheatgrass Fairway wheatgrass Tall wheatgrass Rhodesgrass	Stunted growth usually due to adverse physical condition of soil

[1]ESP = exchangeable-sodium-percentage.

Organic Matter. Percentage of organic matter can be used toestimate nitrogen in the soil. This method alone is not always a dependable measure of available nitrogen, but is used with nitrate nitrogen to make nitrogen fertilizer recommendations on many crops.

Sand %	*Clay %*	*Classification*
< .5	< 1.0	very low
.5–1.0	1.0–2.0	low
1.0–1.5	2.0–3.0	moderate
> 1.5	> 3.0	high

Texture. Coarse-textured soils lack both nutrient and water holding capacities. Fine-textured soils often have structural and infiltration problems.

Material	*Texture*
Sand, loamy sand	coarse
Sandy loam, fine sandy loam	moderately coarse
Very fine sandy loam, loam, silt loam, silt	medium
Sandy clay, silty clay, clay	fine

Nitrate Nitrogen. Nitrate nitrogen is the measure of readily available nitrogen in the soil and is used with percentage of organic matter to make a nitrogen fertilizer recommendation. Because nitrate-N is highly soluble, it is subject to leaching in all soils, especially in coarse to medium textured soils. A fertilizer recommendation for nitrogen is more accurate if the subsoil is sampled 18 to 36 inches deep and tested for nitrate-N. Split applications of nitrogen fertilizer help reduce the potential for leaching. This practice is particularly important for sandy soils.

Parts per million	*Classification*
< 10	low
10–30	moderate
> 30	high

Bicarbonate Phosphorus. Soils in New Mexico are usually low in available phosphorus because phosphorus is quickly tied up in calcareous soils. Bicarbonate phosphorus, also known as $NaHCO_3$-P or Olsen-P, measures water soluble P, highly soluble calcium P, and organic P.

Parts per million	*Classification*
< 7	very low
8–14	low
15–22	moderate
23–30	high
> 31	very high

Soluble Potassium. Adequate potassium is usually available in the strongly weathered soils of New Mexico which have not been leached by high rainfall. Potassium does not readily tie up in calcareous soils and may be found at elevated levels in some saline soils. Potassium fertilizer responses may sometimes be observed on sandy soils with low cation-exchange capacities.

Parts per million	*Classification*
< 30	low
30–60	moderate
< 60	high

DTPA Extractable Iron. Iron deficiency is often a problem with sensitive crops grown in soils with pH values over 7.5. Although the critical level of iron in soils is 4.5 ppm, iron-sensitive crops often can be grown satisfactorily down to levels of 2.5 ppm if rooting is not restricted by caliche or gypsum, and care is taken not to over-irrigate. Some crop varieties are more susceptible to iron deficiency than other varieties.

Parts per million	*Classification*
< 2.5	low
2.5–4.5	moderate
> 4.5	high

DPTA Extractable Zinc. Zinc deficiency is an important problem in some crops, especially corn and grain sorghum. It is especially a problem in soils with pH values over 7.5 or soils that have a long history of heavy P fertilization. Some crop varieties may be more sensitive to zinc deficiency than other varieties.

Parts per million	*Classification*
< 0.5	low
0.5–1.0	moderate
> 1.0	high

DPTA Extractable Copper. Copper deficiencies have not been verified in New Mexico. Factors contributing to copper deficiencies include high organic matter, sandy texture, and high pH.

Parts per million	*Classification*
< 0.3	low
0.3–1.0	moderate
> 1.0	high

DTPA Extractable Manganese. Manganese deficiencies have not been verified in New Mexico. They usually occur under conditions similar to those in which iron and zinc deficiencies occur. Manganese levels in the soil can also vary with the soil moisture content.

Parts per million	*Classification*
< 1.0	low
1.0–2.5	moderate
> 2.5	high

Conversion Factors

Soil test results can be converted from parts per million (ppm) to pounds per acre by multiplying ppm by a conversion factor based on the depth to which the soil was sampled. Because a slice of soil 1 acre in area and 3 inches deep weighs approximately 1 million pounds, the following conversion factors can be used:

Soil sample depth inches	*Multiply ppm by*
3	1
6	2
7	2.33
8	2.66
9	3
10	3.33
12	4

Fertility Considerations

A good soil sample and an accurate soil test interpretation are not the only considerations for good yields and maximum profit in crop production. Although the appropriate amounts of fertilizer based on a soil test are recommended and applied, other factors override the effects of fertilizer by limiting the yield potential of a crop. These factors include 1) the soil type in the field, 2) proper insect and disease control, 3) irrigation water quality, and 4) irrigation water management. Of these factors, the soil type and irrigation water quality are difficult for the grower to control. However, insect and disease control and water management are under the direct control of the grower and his management skills. Favorable fertilizer response is usually related to how well a crop is managed.

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