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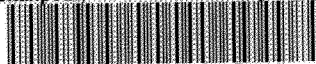
# Soil test explanation

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## Quick Facts

Colorado State University routinely analyzes soil samples for pH, soluble salts, organic matter, nitrate nitrogen, phosphorus, potassium, zinc, iron, copper, manganese, lime and soil texture.

Additional tests for gypsum and the sodium adsorption ratio (SAR) may be run in the laboratory.

Nutrient levels are reported as parts per million (ppm) of the elemental nutrient.

Included in a report from the CSU Soil Testing Laboratory are interpretations which relate results to fertilizer and management recommendations.

On July 1, 1977, the Colorado State University Soil Testing Laboratory adopted a new soil test developed by Dr. P.N. Soltanpour and Mr. A.P. Schwab. This test extracts phosphorus, potassium, zinc, iron, copper and manganese simultaneously. It replaces three separate tests previously used for extraction of these same nutrients. The new test is faster and more economical than the tests it replaces.

Following are the general interpretations for the new soil test (ammonium bicarbonate-DTPA) and other tests presently used by the CSU Soil Testing Laboratory.

## Routine Soil Tests

**Soil pH**, determined by the saturated paste method, indicates the acidity or alkalinity of soil based on a scale of 0-14. On the pH scale, 7.0 is neutral, values below 7.0 are acid and those above are alkaline. Most Colorado soils are alkaline, having a pH between 7.0 and 8.0. A pH value above 8.5 indicates that the soil contains excess sodium.

**Soluble salts** are measured by the electrical conductivity of a soil extract from a saturated paste and are reported in mmhos/cm. Crops vary markedly in their tolerance to soluble salts. Therefore, the values must be interpreted in relation to the specific crop. (See Table 1.)

Detailed information on individual crops is

given in Service in Action sheet .505, *Crop tolerance to soil salinity*.

**Organic matter (O.M.)**, reported as percent of total soil, contains about 95 percent of all soil nitrogen (N). About 30 pounds (13.6 kilograms) N per acre, will be released (mineralized to nitrate) during the cropping season from each one percent O.M. present. Nitrogen release rates will be slower in mountain meadow and other high elevation soils.

**Nitrate nitrogen**, reported in ppm  $\text{NO}_3\text{-N}$ , is soluble and readily available for plant uptake and is therefore considered equally available as fertilizer N. To determine the approximate pounds  $\text{NO}_3\text{-N/acre-foot}$  (one acre to a depth of one foot), multiply the soil test value (ppm) by 3.6. For example, 10 ppm  $\times 3.6 = 36$  pounds  $\text{NO}_3\text{-N/acre}$  (to a depth of one foot).

**\*Phosphorus, potassium, zinc, iron, copper and manganese:** the interpretations for these nutrients are given in Tables 2 through 7. When the soil test is very low to medium, fertilizer response is expected. Fertilizer recommended for "high" testing soils is for maintenance (to maintain soil fertility at that desirable level). No fertilizer is recommended for soils testing "high" for dryland production. For the micronutrients, no fertilizer is recommended when the test indicates "adequate." To date there has been no confirmed field crop response to copper or manganese fertilization in Colorado.

**Lime ( $\text{CaCO}_3$ )** is reported as percent free lime. In the routine test, values are reported as low (0-1%), medium (1-2%), and high (above 2%). Specific values are determined and reported only when a sodium evaluation is requested on a sample. In this case the percent free lime content is important in determining whether elemental sulfur will be an effective amendment in sodium reclamation. The lime content has no direct bearing on soil test interpretations for fertilizer recommendations by the CSU Soil Testing Laboratory.

**Texture** is estimated by the "hand-feel" method. Nitrogen management suggestions are

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adjusted according to soil texture. It is important on sands, loamy sands and sandy loams that nitrogen applications be split to avoid mid- or late-season deficiency. It is also recommended that high nitrogen rates be split for many crops.

### Additional Soil Tests

*Sodium adsorption ratio (SAR)* is determined by saturated paste extraction and is reported as a special ratio of sodium to calcium plus magnesium.

This test evaluates the sodium content of soil. A value of 15 or greater indicates an excess of sodium will be adsorbed by the soil clay particles. Excess sodium can cause soil to be hard and cloddy when dry, to crust badly, and take water very slowly.

Gypsum test is conducted in conjunction with the SAR test. Total gypsum is reported in meq. (millequivalent)  $\text{CaSO}_4/100\text{g}$ . If sufficient native gypsum is present, sodium-affected soils may be successfully treated without addition of amendments such as gypsum or sulfur. The gypsum supplies soluble calcium to replace the adsorbed sodium and reclamation can proceed if drainage of the land is possible.

Table 1: Tolerance levels of crops for soluble salts.

| Test values in mmhos/cm | Interpretation           |
|-------------------------|--------------------------|
| 0-2                     | Satisfactory for crops   |
| 2-4                     | Affects sensitive crops  |
| 4-8                     | High for many crops      |
| above 8                 | Very high for most crops |

Table 2: Available phosphorus (ammonium bicarbonate-DTPA test).

| Test values* in ppm | Interpretation       |                    |
|---------------------|----------------------|--------------------|
|                     | Irrigated production | Dryland production |
| 0-3                 | Very low             | Low                |
| 4-7                 | Low                  | Medium             |
| 8-11                | Medium               | High               |
| 12-15               | High                 |                    |
| above 15            | Very high            |                    |

Table 3: Available potassium (ammonium bicarbonate-DTPA test).

| Test values* in ppm | Interpretation       |                    |
|---------------------|----------------------|--------------------|
|                     | Irrigated production | Dryland production |
| 0-60                | Low                  | Low-medium         |
| 61-120              | Medium               | High               |
| 121-180             | High                 |                    |
| above 180           | Very high            |                    |

Table 4: Available zinc (ammonium bicarbonate-DTPA test).

| Test values* in ppm | Interpretation       |                    |
|---------------------|----------------------|--------------------|
|                     | Irrigated production | Dryland production |
| 0-0.50              | Very low             | Low                |
| 0.5-0.99            | Low                  | Marginal           |
| 1.0-1.50            | Marginal             | Adequate           |
| above 1.50          | Adequate             |                    |

Table 5: Available iron (ammonium bicarbonate-DTPA test).

| Test values* in ppm <sup>1</sup> | Interpretation                   |  |
|----------------------------------|----------------------------------|--|
|                                  | Irrigated and dryland production |  |
| 0-3.0                            | Low                              |  |
| 3.1-5.0                          | Marginal                         |  |
| above 5.0                        | Adequate                         |  |

<sup>1</sup>Values below 10.0 may be deficient for turf and many ornamentals.

Table 6: Available manganese (ammonium bicarbonate-DTPA test).

| Test values* in ppm | Interpretation |
|---------------------|----------------|
| 0-0.5               | May be low     |
| above 0.5           | Adequate       |

Table 7: Available copper (ammonium bicarbonate-DTPA test).

| Test values* in ppm | Interpretation |
|---------------------|----------------|
| 0-0.2               | May be low     |
| above 0.2           | Adequate       |

\*This test is an availability index. It does not measure the total amount in soil, but only that fraction extractable by the soil test.