



No. 70

Extension Bulletin 937

January 1976

Understanding the MSU Soil Test Report: *results and recommendations*

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THE MSU SOIL TEST REPORT FORM can be divided into two basic parts:

- (1) test results (see Table 1) and
- (2) fertilizer recommendations (see Table 2).

Soil test results are presented on the left side of the report.

TEST RESULTS

Soil pH indicates the level of active soil acidity or alkalinity. Above 7.0 is alkaline, 7.0 is neutral and below 7.0 is acid. This measurement, sometimes referred to as the water pH, is made with soil in distilled water. A pH between 6.0 and 6.5 is best for most field crop production. Alfalfa, however, grows best at pH 6.6 - 7.2.

Lime index indicates the reserve or potentially active acidity in soil. Lime index measurements are made only on samples testing less than pH 6.8. The lime index measurement of the soil is made with a solution buffered at pH 7.5. The greater the decrease in pH level, lime index value, from 7.5, the more lime required to bring the soil pH back up to 6.5. For more detail, see Extension Bulletin E-471 (Lime for Michigan Soils).

Available phosphorus, potassium, calcium and magnesium are reported in pounds per acre to a depth of 6 $\frac{3}{8}$ inches. For mineral soils, this is about the same as parts per 2 million (pp2m).

Phosphorus (P) levels of less than 20 pounds per acre are very low, 40 - 60 pounds per acre medium and above 100 pounds per acre very high for field crops. Vegetables require higher levels of available P so that a soil test of 100 to 150 pounds per acre is desirable.

Potassium (K) tests of less than 60 pounds per acre are very low for field crops, 160 to 210 pounds per

acre medium and above 300 pounds per acre very high. For vegetables, a potassium test level of 300 to 350 pounds per acre is desirable.

Calcium (Ca) is generally adequate in Michigan field soils. Even acid soils needing lime generally contain sufficient calcium for plant growth. This test is used to calculate nutrient balances and, indirectly, to make magnesium recommendations.

Magnesium (Mg) is considered adequate when tests are above 75 pounds per acre in mineral soils and above 150 pounds per acre in organic soils. Mg levels, as a percent of the total bases, less than 3 percent are considered low. Another criterion for evaluating Mg involves nutrient balance. If K exceeds Mg, as a percent of the total bases (Ca + Mg + K expressed as milliequivalents) Mg levels are also inadequate for many crops.

Micronutrient analyses are made only on special request. The zinc, manganese and copper contents of soil are reported in parts per million (2 pounds per acre equals 1 ppm). In Table 1 the farmer requested and paid for the zinc and manganese tests. For interpretation information, see Extension Bulletin E-486 (Secondary and Micronutrients for Vegetables and Field Crops).

PCT ORG MAT is determined only on special request and reported as percent organic matter in the soil.

PCT OF TOTAL EXCHANGEABLE BASES provides information on nutrient balance among potassium, calcium and magnesium. The percentages reported assume K, Ca and Mg comprise 100% of the exchangeable bases, and are used to determine potential magnesium-deficient situations. Mg should be above 3% and greater than percent K. For example, 6.8% K and 4.2% Mg indicates a Mg-deficient soil.

Table 1. An illustration of the left side of the soil test report form — Test Results

| TEST RESULTS | | |
|-----------------------------------|-----------------------|------|
| Sample No. | 3 | 4A |
| Soil pH | 6.0 | 6.9 |
| Lime Index | 6.7 | |
| | lbs. per acre of: | |
| Available Nutrients | | |
| Phosphorus | 17 | 66 |
| Potassium | 206 | 156 |
| Calcium | 1036 | 2465 |
| Magnesium | 70 | 392 |
| | parts per million of: | |
| Zinc | 6 | 4 |
| Manganese | 7 | 15 |
| Copper | | |
| Pct. Org Mat | 3.21 | |
| Pct. of Total Exchangeable Bases: | | |
| Potassium | 8.4 | 2.5 |
| Calcium | 82.4 | 77.1 |
| Magnesium | 9.2 | 20.4 |
| Sample Data | | |
| Acres | 10 | 26 |
| Mgmt. Gp. | 3 | 2 |
| Manure | NO | NO |
| Plowing Depth | 9 | 9 |

MGMT GP indicates the soil texture.

—ORG is organic.

—1 is comprised of clay soils.

—2 includes loam, clay loam, sandy clay loam and similar soils.

—3 is sandy loams.

—4 is loamy sands.

—5 is sand soils.

When indicated, the soil series information is included in the computer program to help determine appropriate fertilizer recommendations. When soil survey information is not supplied, the soil texture is determined by feel. However, soil survey is more desirable.

ACRES represented by the sample, **MANURE APPLIED**, and **PLOWING DEPTH** are information provided by the farmer. For each ton of manure used, the fertilizer recommendation is reduced by 4 pounds N, 2 pounds P_2O_5 and 8 pounds K_2O per acre. The lime recommendation is adjusted for plowing depth if other than 9 inches, but the fertilizer recommendations are not.

RECOMMENDATIONS

Fertilizer recommendations are printed on the right hand portion of the report. Recommendations may

be given for three succeeding years or three crop options if the crops to be grown are indicated by the farmer. **EXP YIELD** indicates expected yield in bushels or tons per acre.

Major Nutrients

Fertilizer recommendations are given in pounds per acre of nitrogen (N), phosphate (P_2O_5) and potash (K_2O). A recommendation of 150 + 100 + 75 means 150 pounds of nitrogen (N), 100 pounds of phosphate (P_2O_5) and 75 pounds of potash (K_2O) per acre.

Fertilizer recommendations are based upon many factors and are on the average considered to be accurate within 10 pounds, assuming that the sample tested is representative, that average weather prevails and that good management practices are used. The accuracy tends to decrease where very low or very high rates are recommended. Thus, the most economical range for nitrogen in the above recommendation lies between 140 and 160 pounds; for phosphate, between 90 and 110 pounds and for potash between 65 and 85 pounds.

Many ways are available for a farmer to supply the nutrients in his recommendation. Four alternatives are considered to illustrate the mechanics of determining what to use.

Alternative No. 1

Use anhydrous ammonia (82-0-0) as a sidedressing, superphosphate (0-46-0) at planting and muriate of potash (0-0-60) as a broadcast plowdown treatment. The rates are determined in the following way:

For nitrogen, divide 82, the percent nitrogen in anhydrous ammonia, into 150, the nitrogen recommendation. The result is 1.83. Because the nitrogen content is expressed as a percent, the 1.83 is interpreted as 1.83 hundred pounds which is equivalent to 183 pounds per acre.

The same method can be used for phosphate. Divide 46 into 100 which is 2.16 hundred pounds or 216 pounds. For potash, divide 60 into 75 which is 1.25 hundred pounds or 125 pounds.

Alternative No. 2

Use muriate of potash (0-0-60) as a broadcast plowdown, 11-48-0 at planting time and anhydrous ammonia as a sidedressing. The amount of potash to use is the same as shown in Alternative 1. By dividing 48 (from the 11-48-0) into 100, the amount of 11-48-0 to use to meet the phosphate requirement can be determined (208 pounds). In 208 pounds of 11-48-0, there are 22.9 or 23 pounds of nitrogen. Deducting 23 pounds from the recommendation of 150 pounds of nitrogen leaves 127 pounds of nitrogen still to be supplied.

Using the method as shown in Alternative No. 1, the amount of anhydrous ammonia required to supply this amount is equal to 155 pounds.

Alternative No. 3

Use a nitrogen solution (28-0-0) as a plowdown and a blend of 11-48-0 and muriate of potash as a planting time fertilizer. In this situation, start with 11-48-0. In Alternative 2, it was determined that 208 pounds would meet the phosphate requirement and in Alternative 1 that 125 pounds of 0-0-60 would supply the potash for 1 acre. The blend would be applied at planting time at the rate of 333 pounds per acre (208 + 125).

To fulfill the nitrogen requirement, deduct the amount of nitrogen in the 11-48-0 from that recommended (150 - 23 = 127). To meet this requirement, use 28-0-0 at the rate of 4.55 hundreds of pounds per acre or 455 pounds per acre. (127 divided by 28 equals 4.55.)

Alternative No. 4

If you are using a complete fertilizer, some compromising may be necessary. Use 6-24-24 and anhydrous ammonia sidedress. Since 6-24-24 supplies the same amount of P₂O₅ and K₂O, and since the recommendation is for 100 pounds P₂O₅ and 75 pounds K₂O a decision must be made to meet the phosphate or potash requirement or compromise somewhere between. Meeting the phosphate requirement would require 416 pounds per acre (100/24) whereas meeting the potash requirement would require 312 pounds per acre (75/24). Compromising half-way between, or

87 pounds per acre, would require 362 pounds of 6-24-24 per acre. The compromise approach supplies 22 pounds nitrogen per acre (.06 × 362) leaving 128 pounds to be supplied sidedress or 156 pounds anhydrous ammonia (128/82).

Secondary and Micronutrients

In Table 2, B designates boron; Zn, zinc; Mn, manganese and Cu, copper. These elements are called micronutrients. The recommendations are based on crop response, soil pH, and soil test level. Micronutrient recommendations are made on the basis of pounds of the element per acre. Most fertilizer companies sell micronutrients on a percentage basis. Thus, one needs to know which percent to use. The following example illustrates the mechanics of handling this situation.

Assume the same recommendation as illustrated above (150 + 100 + 75) except that the recommendation includes manganese at the rate of 10 pounds per acre.

In Alternative No. 1 above, manganese could be blended in with the 0-46-0 and used as recommended as part of the planting time fertilizer.

In Alternative 2 it could be blended as part of the 11-48-0.

In Alternative 3 it could be mixed with the blend of 11-48-0 and 0-0-60.

The manganese (Mn) carrier will determine how much will be needed to supply the 10 pounds Mn. Manganese sulfate contains about 26 percent Mn.

Table 2. An illustration of the right side of the soil test report form — Fertilizer Recommendations

| SAMPLE 3 | | Exp. Yield | Nitrogen N | Phosphate P ₂ O ₅ | Potash K ₂ O | B | Zn | Mn | Cu | Notes |
|----------------|----------|------------|------------|---|-------------------------|---|----|----|----|-------|
| Previous Crop: | Corn | | | | | | | | | |
| Future Crops: | | Lbs/A | | | | | | | | |
| 1st Yr. | Corn | 120 - 149 | 150 | 100 | 75 | — | 0 | 0 | — | 1 2 |
| 2nd Yr. | Soybeans | 40+ | 40 | 75 | 50 | — | 0 | 0 | — | 1 |
| 3rd Yr. | Wheat | 40 - 65 | 60 | 100 | 50 | — | 0 | 0 | — | 1 2 |

Lime needed for pH 6.5 = 2.5 T/A.

Lime needed for pH 6.8 = 3.0 T/A.

1 Magnesium tests low. Use Dolomite and/or soluble Mg in the fertilizer.

2 Band a minimum of 25 Lb/A P₂O₅ near the seed in the starter fertilizer.

SAMPLE 4A

| SAMPLE 4A | | Exp. Yield | Nitrogen N | Phosphate P ₂ O ₅ | Potash K ₂ O | B | Zn | Mn | Cu | Notes |
|----------------|---------------|------------|------------|---|-------------------------|-----|----|----|----|-------|
| Previous Crop: | Corn | | | | | | | | | |
| Future Crops: | | | | | | | | | | |
| 1st Yr. | Beans — Field | 30 - 50 | 40 | 0 | 60 | — | 3 | 4 | — | 1 |
| 2nd Yr. | Sugar Beets | 18 - 23 | 60 | 50 | 100 | 3.0 | 0 | 3 | — | |
| 3rd Yr. | Corn | 120 - 149 | 150 | 25 | 100 | — | 3 | 4 | — | 1 |

1 Band a minimum of 25 Lb/A P₂O₅ near the seed in the starter fertilizer.

Therefore, 38 pounds ($10 \div 26$) of manganese sulfate should be blended with the amount of fertilizer required per acre. This would be 333 pounds of the 11-48-0 and 0-0-60 blend in Alternative No. 3, and would be 362 pounds of 6-24-24 in Alternative No. 4.

Where standard fertilizer is used, determine first the rate required to supply the major element. Then determine the percent micronutrient needed to meet the recommendation. To illustrate this point, assume that 200 pounds per acre of 8-32-16 are to be used. In this instance, a 5 percent manganese material would be required to supply the recommended amount of 10 pounds Mn per acre. If only 100 pounds per acre of 8-32-16 were to be used at planting time, a 10 percent material would be required to supply the 10 pounds of manganese.

The need for additional magnesium is indicated by a footnote, "Magnesium Tests Low. Use Dolomite

and/or Soluble Mg in the Fertilizer." When lime is required, magnesium is best supplied with dolomitic limestone. A magnesium deficient situation may also be corrected by 50-100 pounds Magnesium per acre broadcast or 10-20 pounds magnesium per acre row applied.

Footnotes are printed out in special situations to help the farmer maximize crop production through proper fertilizer management.

Both your county agricultural agent and fertilizer dealer are in a good position to help you interpret your recommendation sheet. Use their services.

LAB: If you have an inquiry to make about your sample, contact the SOIL TESTING LABORATORY, MICHIGAN STATE UNIVERSITY, EAST LANSING, MI 48824. Indicate the tray number shown at the lower left portion of the soil test report.