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Soil Testing in Connecticut

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SOIL SAMPLE

THE SOIL sample should be a thorough mixture of equal amounts of soil collected at 20 or more points well distributed over the field or area in question. Vertically cut shovel or trowel slices of uniform thickness, or borings, should be taken. For cultivated soils, sample to the depth of six inches. Permanent sod, as in pastures and lawns, should be sampled from the upper two inches. If desired, separate samples of soil from lower depths may be made. Mix the soil thoroughly, and remove stones, coarse roots or hard clods. Each sample should be packed in a clean carton, box or bag not previously used for drugs, chemicals or other contaminating substances. An unused half-pint ice cream carton is quite desirable. The County Farm Bureaus supply suitable mailing tubes. Each sample should be marked by number, name of field or other identifying legend.

If there are distinct types of soil in the field, or important differences in past treatment or crop growth, separate samples should be submitted.

Soils are received for testing at the following laboratories:

Agronomy Department, Connecticut State College, Storrs

Tobacco Substation, Windsor

Soils Department, Connecticut Agricultural Experiment Station, New Haven

INFORMATION ACCOMPANYING SOIL SAMPLES

Record sheets, letters or notes accompanying samples must indicate *the crop or crops involved*, and as much as possible of the following information:

1. Land surface (whether hilly, rolling or level).
2. Drainage, either natural, or as improved by tile or ditches.
3. Underlying formation, whether "hardpan", sand, gravel or rock.
4. Special soil features, such as mellowness or hardness, tendency to erode, unusual shallowness of soil, stoniness, etc.
5. Crops grown in past few years, and description of any abnormal results not caused by other factors.
6. Soil treatment with respect to lime, manure, fertilizers, etc., in recent years.
7. Approximate area represented by the sample.
8. Amount and kind of manure available for soil improvement.
9. Description of all unusual conditions.

When the samples are brought to the laboratory, most of this information may be given orally.

This circular should be kept on file for future reference, along with all soil testing records and reports.

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M. F. MORGAN, T. R. SWANBACK AND J. S. OWENS*

DURING the past six years the methods of soil testing developed by the Soils Department of this Station† have been applied to approximately 40,000 samples of soil from Connecticut fields, orchards, gardens and lawns. During 1938 at least 12,000 tests have been made at the three state laboratories offering this service.

It is confidently believed that recommendations for soil improvement practices have been greatly facilitated as a result of the information supplied by the soil tests. Many conditions of poor chemical balance in the soil have been revealed that would have been otherwise overlooked. Errors in diagnosis, either through faults in laboratory technique or in judgment in interpreting the tests, have often been made; but these have rarely been of harmful consequence. Increased experience in using and interpreting the tests has improved the accuracy of our diagnosis from year to year.

The present large demand for soil testing at public expense requires that soil samples be submitted for examination only in cases where there is a definite need for the information furnished by the soil tests, and that such samples be properly taken and carefully described. Many of those coming to us are found not to be representative of the area from which they are taken. Sometimes no information is received concerning the past treatment of the soil and the crops to be grown. On the other hand, records of previous treatment, crop performance and soil qualities clearly evident in the field are often sufficient to indicate the state of fertility without a soil test.

A better understanding of the uses and limitations of soil test data is needed if the service is to be of maximum benefit. This circular is designed to promote that end.

Important Information Supplied by Soil Tests

Tests for pH reveal degrees of acidity, or alkalinity, that may be harmful to the crop. With due attention to the clay and humus contents of the soil, amounts of lime needed to correct undesirable acid conditions are reasonably indicated.

The Universal Soil Testing methods developed by this Station and used by soil testing agencies in this State and many others are described in Circular 127. These show the approximate fertility levels of the soil with respect to the following constituents: nitrate nitrogen, ammonia nitrogen, phosphorus, potassium, calcium, magnesium, aluminum and manganese. Other tests that may be made as occasion demands are as follows: iron, boron, copper, zinc, sodium, chlorine, sulfate, nitrite and carbonate.

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† Circular 127: Soil Testing Methods. The Universal Soil Testing System.

The **nitrate** and **ammonia nitrogen** tests show the immediately available nitrogen, but do not tell how much nitrogen may later be liberated from organic substances in the soil.

The **phosphorus** capable of becoming soluble through normal soil processes is fairly well approximated in most instances.

The **potassium** (potash) available to most cultivated crops is clearly indicated. However, many crops, particularly perennial forage crops, shrubs and trees seem able to obtain considerable potash from the more difficultly soluble forms, not shown by the test.

The **calcium** status of the soil is definitely revealed. This is important in its relationship to acidity, the physical quality of the soil, and the balance between the various base constituents of the soil, calcium, magnesium, potassium and sodium.

The **magnesium** test identifies cases where magnesia treatments as dolomitic lime or as sulfate of magnesia, Epsom Salts or Emjeo, are likely to be beneficial. It also indicates whether or not this base is suitably balanced in proportion to others in the soil.

Aluminum is associated with a type of acidity that is most harmful to acid-sensitive crops. High aluminum tests are usually directly related to low phosphorus availability.

Manganese may be in deficiency, when only faint traces are given by the test. This is especially true of soils that have been limed heavily. On the other hand, strongly acid soils high in active manganese produce an unusual type of crop injury that may be corrected by liming.

Active **iron** accumulation indicates unfavorable drainage conditions. A negative test may indicate an iron deficiency, especially on over-limed soils. However, this condition has not been definitely identified in Connecticut.

Boron, copper and **zinc** are essential for plant growth, in minute amounts, and are harmful in excessive concentrations. The methods are not yet sufficiently refined for definite identification of deficiency conditions, but are helpful in revealing injurious accumulation.

Sodium and **chlorine** in unusual amounts are indicative of salt water contamination, resulting from sea spray or tidal flooding. These tests were especially helpful in tracing the gradual disappearance of salt left in the soil by the 1938 hurricane and tidal wave.

Sulfates, while essential to plant growth, are not known to be in deficiency, since the rainfall brings down sulfur in adequate amounts. The sulfate test is needed only in cases where some unusual contamination is suspected.

The **nitrite** form of nitrogen accumulates in the soil to a harmful degree in occasional unusual conditions of poor soil aeration and decomposing organic nitrogenous material. This is readily identified by the soil test.

Carbonates in the soil are usually associated with lime in excess of needs for acidity correction. This is seldom the case in this section of the country, but the identification of carbonates serves to confirm an unusually high pH test.

The trained observer can usually make a reasonable estimate of the relative amount of organic matter (humus), sand and clay in the soil by eye and hand examination. However, in questionable cases, where these factors are likely to be significant in the adaptation and management of the soil, laboratory determinations may be made. The loss in weight suffered by dry soil upon prolonged ignition is a fair approximation of the **organic content**. The hydrometer method of **mechanical analysis** shows the proportions of sand, silt and clay.

Interpreting Soil Tests

All of the above conditions must be interpreted with respect to one another. The modifying influence of adverse factors existing in the field, not revealed by laboratory soil examination or chemical test, must be estimated. The individual needs of the crop must be considered. A hasty recommendation based on independent consideration of a single soil test, unsupported by information that can be supplied only by the farmer, gardener or grower, may be definitely misleading. The helpfulness of soil testing is in direct proportion to the training and sound judgment of the person responsible for the interpretation of the tests.

Soil Test Needs Under Various Crop Conditions

Pastures: The use of lime and fertilizers supplying phosphorus and potash in the top dressing of pastures and the seeding of pastures in rotation with other crops can be best directed by soil tests. Neither soil tests nor treatments are justified on fields overgrown with brush and trees, or on soils especially deficient in moisture due to shallowness to bedrock, excessive sandiness or the gravelly condition of the underlying material.

Hay crops: Successful seeding and maintenance of legumes, such as alfalfa and clover, can rarely be accomplished under Connecticut conditions without careful attention to lime, phosphorus and potash needs. When good yields of grass hay are maintained by the use of manure or nitrogen top dressings, soil tests serve no useful purpose except as indicating the treatment needed when the sod is plowed up for other crops.

Corn: When a manure treatment gives satisfactory yields, the soil test is frequently not justified for this crop under average dairy farm conditions. However, the soil may be especially deficient in phosphorus, requiring superphosphate as a supplement or re-enforcement to the manure. When the subsequent hay crop is to be seeded down between the corn rows, testing is advisable to estimate its special needs.

Potatoes: Commercial potato growing involves the use of large amounts of fertilizer. Irrespective of soil tests, amounts supplying from 80 to 100 pounds of nitrogen, and from one and one-half to two times these amounts of both phosphoric acid and potash, per acre, appear to

be profitable. Old tobacco soils with unusual accumulations of available phosphorus may not respond to more than half as much phosphoric acid as is customarily used for potatoes.

Many potato fertilizers tend to increase the acidity and the calcium and magnesium deficiencies of the soil. Soils testing below 5.0 pH frequently respond to a few hundred pounds of dolomitic limestone per acre. On the other hand, potato scab is likely to be troublesome on soils less acid than 5.6 pH. Magnesia is best applied as the sulfate when the pH exceeds 5.0.

Vegetable crops: Most vegetable crops justify heavy fertilization. Even though soil tests may indicate some accumulation of chemical fertility, no drastic modification of the fertilizer program is justified. Frequently soil tests permit a more intelligent choice of fertilizer ratios. For instance, on a soil fairly high in phosphorus and no better than medium in potash, a 1-2-2 ratio is desirable. Conversely, on a soil low in phosphorus and quite well supplied with potash, the 1-3-1 ratio would be more suitable.

The simple field kits for acidity testing, now readily available to the farmer from commercial sources, are frequently adequate to guide the use of lime for vegetable crops. Occasional samples, tested more accurately in the laboratory, help to calibrate the field-test results.

The nitrate tests are especially useful during the growing season to indicate whether or not a side-dressing application is likely to be beneficial.

Tobacco: This crop is especially exacting in its demands upon the soil, both with respect to yield and quality for cigar uses. Soil tests taken in advance of planting help to identify: seriously low pH, justifying lime, or a high pH favorable to black root rot; phosphorus tests sufficiently low to suggest more phosphate than is supplied by the organic materials in the fertilizer formula; a need for more than 200 pounds of potash per acre, on soils especially deficient in potash; the magnitude of the magnesia requirement; a deficiency in calcium unfavorable for physiological balance in tobacco nutrition, especially on acid sandy soils not limed or fertilized with precipitated bone; manganese in amounts likely to injure the color of the ash.

Soil tests during the growing season are especially valuable when there is doubt as to the need for side-dressing treatment, after leaching rains.

Orchards: There appears to be no direct correlation between soil tests and the growth or yield of the fruit trees themselves. However, sane orchard soil management demands good growth of cover crop or sod mulch. The needs for lime, phosphorus and potash to benefit the ground cover are revealed by soil tests. The organic content of orchard soils requires particular attention, and laboratory determination may be needed in critical cases.

Home gardening: The amateur gardener, in city or suburban location, is often confused by the various soil management suggestions he or she receives from garden journals, garden club speakers and radio programs. Frequently there is uncertainty as to the fertility level of the garden or lawn soil, especially on new developments or when the householder takes over an old location with little or no information as to past treatment or results. In such instances the soil testing service can be of much help.

Greenhouse crops: Flowers and vegetables grown under glass demand fertility levels much in excess of outdoor crop needs. The plant must obtain its nutrients from a much smaller quantity of soil, even though a much larger production is demanded. In the past, manure, bonemeal and lime were rather indiscriminately used for soil improvement. At present, the trend is toward more intensive feeding with commercial fertilizers. Unless these are carefully and systematically applied, the soil may become seriously unbalanced with respect to accumulations of the various fertilizer constituents. Tests of representative soils at successive stages of the crop cycle enable the grower to keep the soil in a favorable state of fertility. When the scale of operations justifies the expense, a systematic program of soil testing by the producer is desirable. Information along this line will be supplied on request.

Soil Testing Is Often Unnecessary

Many soils have been intelligently managed over long periods, and crops are all that can be expected in view of other limiting factors, such as seasonal conditions, plant pests, and soil conditions not subject to correction. Other land has been so neglected in the past that a state of chemical infertility is clearly indicated by the poor production. In such cases a soil test is not needed to show favorable or unfavorable conditions.

Some growers, particularly in the tobacco district, have thought it desirable to have soil tests made each year, even when the previous tests have shown no abnormal conditions and the fields have produced as well as could be expected. Such a program of soil testing is seldom justified, and places a serious demand upon the limited facilities of the state soils laboratories offering free service.