Rutgers
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Soil Fertility and Planting Decisions in Absence of a Current Soil Test Report

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Applying soil amendments and planting crops without a current soil test is not recommended in normal times. However, with the temporary shutdown of the Rutgers Soil Test Lab in association with the COVID-19 pandemic, growers are faced with making soil fertility decisions without a current report. The purpose here is to provide some guidance with regards to liming, soil pH management, and application rates of appropriate fertilizers.

If a farm has a good history of conducting regular soil testing, old reports on file can still provide some guidance. Also, cropping history, harvest records, field observations, and records of previous applications of liming materials and fertilizers can provide useful information for agronomic decision-making. By observing patterns of change with different amendments and crops over a field's history, one can make estimates of soil fertility requirements for the short term.

The soil texture, although not determined by a standard soil fertility test, has a major influence on application rates of soil amendments, especially limestone. There are four broad categories of soil texture common in New Jersey: loamy sand, sandy loam, loam, or silt loam. Soil texture can be estimated by hand feel. Sandy soils feel grainy and fall apart easily, silty soils feel smooth, and clayey soils are cohesive or sticky and can be molded into stable structures. Loams have a balance of the three components: sand, silt, and clay.

Another way to determine soil texture is with the Web Soil Survey, (http://websoilsurvey.nrcs.usda.gov/), an online soil map resource which is available from USDA NRCS. It provides surface texture of the native/undisturbed soil of a specific area. Since texture is a permanent fixture of a soil type, once it has been determined, it is a property worth remembering. However, surface soil texture can be impacted by excessive disturbance such as deep tillage, erosion, or sedimentation.

Liming and Soil pH Management

Matching the target soil pH with intended crop is of fundamental importance for crop production. Maintaining pH in the optimum range is important to nutrient availability as well as protection from metal toxicity. To give some target soil pH examples, for blueberry the soil pH should be near 4.8, for peaches and tomato 6.5, and for asparagus and alfalfa 6.8. NJAES fact sheets provide more examples. https://njaes.rutgers.edu/pubs/

Annual crops such as vegetables, corn, soybean, and small grains provide greater opportunity for soil pH correction. However, another factor to keep in mind with regards to liming is that heavy and/or repeated application of urea, organic, and ammonium-nitrogen fertilizers is one of the major causes of soil acidification. Low rates of limestone application may be warranted as “maintenance” treatment until a soil test can confirm the limestone requirement.

Before establishing perennial crops, especially fruit trees, it is very important to take care of any need for liming well in advance of planting. When limestone is required, tillage should be used to mix this amendment into the soil. Once rows of apple trees or grape vines are planted, it is very difficult to apply limestone and do the necessary tillage. These high-value crops are expected to be in place for many years, and any acidity correction should be based on a soil pH measurement made in advance.

For established perennial crops, keep in mind the acidification factor of many N fertilizers: repeated or heavy application of nitrogen fertilizers is one of the major factors causing soil acidification, and low rates of limestone application may be warranted as “maintenance” treatment.

Many relatively inexpensive and reliable soil pH meters are available for purchase. When properly calibrated, soil pH meters can be a useful tool in the absence of a professional laboratory soil test.

Once soil pH has been determined, that data along with knowledge of the soil texture can be used to figure out how much limestone in pounds per acre to apply using the tables in the several fact sheets that are available (Rutgers NJAES website) for tree crops, vegetables, and field and forage crops.

After determining the limestone application rate, the next question concerns which type to use. This is where a professional soil test is most helpful because it shows the balance for needed calcium or magnesium as supplied by limestone.

In general, the type of limestone is less important than applying the correct amount. Relative levels of calcium and magnesium change slowly. If previous soil test reports indicated an imbalance between calcium and magnesium availability, take that into consideration when selecting a liming material. Also consider any amendments that have been applied since the most recent report that might affect the current calcium/magnesium balance. In the absence of soil test information, high calcium limestones are preferred for tree fruit crops. For pastures, high magnesium limestones are preferred because magnesium is very important to animal health.

Wherever the types of crops produced and rotation system followed stays much the same over a period of years, generally the liming practice and application rates and schedule that worked well in the past may be continued.

Nitrogen (N)

Although a very important and often needed nutrient, regular soil fertility testing does not test for N. There is, however, a special test for N called the PSNT or in-season soil N test for annual crops such as corn and some vegetable crops used to predict need for supplemental N fertilizer. Otherwise, fertilizer N rate recommendations are based on the crop’s growth cycle and the cropping system, considering factors such as previous crop in rotation, recent manure/compost applications, and cover crops. Soil organic matter content is also factor.

Phosphorus (P)

Over half of the soil samples tested at the Rutgers Soil Test Lab find above-optimum levels of soil test P. Because this nutrient is strongly bound to soil particles, very little washes out of soil by leaching. Also, because removal of P by crop harvest is about ten times less than for other major nutrients, applied P tends to accumulate, often leading to above-optimum levels. In addition to commercial fertilizers, manure/compost applications can add substantial amounts of P to soil reserves.

As an example, if a soil test report from three years ago found soil test P levels were in the above-optimum range, a new soil test would very likely still test above-optimum. In such a case, an old soil test report is still useful to gauge the need for P fertilizer. When soils test above optimum, the only P fertilizer that might be recommended is a low rate (about 20 lbs./acre) of P starter fertilizer applied near the seed row at time of planting. This accounts for the limited root size during the seedling stage and compensates for P immobility in the soil.

In the case of an old soil test report showing that the soil test P level was in the optimum range, apply as much P as expected the crop harvest will remove.

Potassium (K)

Crop harvest typically removes much more K than P. And when the total above-ground biomass is harvested as hay or as silage, a substantial amount of available K is removed from soil. Repeated harvests, especially from sandy soils, can rapidly deplete K and result in K deficient crops.

Horticultural crops such as tomato, peaches, melons and similar crops must have a good supply of K to be able to pack water into cells and ensure that fruits are made large, succulent, and juicy.

In the absence of recent soil test data, it is better to apply some K fertilizer as a matter of insurance. In this case, crop removal values for K may be used as a rough guide to application rates for K fertilizer.

Sulfur (S)

At the present time S is not reported by soil testing at the Rutgers Soil Test Lab. The potential for S deficiency is becoming more common since air pollution efforts are resulting in decreased amounts of S coming free from the atmosphere. Sulfur nutrition is very important for making quality proteins, as well as certain types of vitamins and flavor compounds in vegetables.

Soils recently amended with manures or compost may be expected to have adequate available S. Sandy soils and soils low in organic matter content are fields where there is a high risk of S deficiency. Vegetable crops with a high demand for S include those in the cabbage family, onions, and sweet corn.

An annual S application of 20 to 40 lbs./acre is a reasonable application rate. Often an abundance of S can be supplied by thoughtful selection of N and K fertilizers. For example, ammonium sulfate and potassium sulfate are excellent S fertilizers. Gypsum is also another good S fertilizer.

Calcium (Ca) and Magnesium (Mg)

In most cases Ca and Mg are well supplied as liming materials. See section on liming above. Calcium is also a component of superphosphate, gypsum, and calcium nitrate fertilizers. Magnesium is a component of potassium magnesium sulfate fertilizer.

Micronutrients: Boron (B), Copper (Cu), Iron (Fe), Manganese (Mn), and Zinc (Zn)

The availability of micronutrients is influenced by soil pH. Managing soil pH is critical to maintaining micronutrient availability. Except for molybdenum, availability of micronutrients, deceases as soil pH increases.

Boron-deficient soils are commonly identified by soil testing. Alfalfa and cruciferous vegetables are crops that very often need B fertilizer. An application rate of 2 to 3 lbs. B/acre is reasonable for alfalfa, and 1 to 2 lbs./acre for cabbage, broccoli, and cauliflower. Other vegetable crops need less B, and one must be careful to never apply excessive rates of B fertilizer since it may cause toxicity. A moderate rate of about 0.5 lbs. B/acre is enough for many types of vegetables.

Copper deficiency is not common on New Jersey soils. Many soils contain considerable amounts of plant-available Cu as a result of spraying copper fungicides.

Iron deficiency occasionally occurs in certain crops, such as blueberry, that prefer acid soils. High pH soils, where excessive amounts of liming materials have been applied, may induce an Fe deficiency. Iron deficiency is exhibited on younger leaves as yellowing, especially between the leaf veins (chlorosis).

Manganese deficiency is very common on a wide range of crops grown on sandy New Jersey coastal plain soils. Deficiency of Mn looks much like Fe deficiency with yellowing of the foliage, especially between the leaf veins. Field sites with a history of exhibiting Mn deficiency can often be expected to need Mn fertilization every year. So even without a recent soil test, one can anticipate the problem of Mn deficiency in fields where it has appeared in the past. Fertilizer Mn applied to the soil is typically converted by microbes to unavailable forms. For this reason, Rutgers Cooperative Extension recommends treatment of Mn deficiency with foliar sprays of Mn fertilizer. Generally, the recommended rate is 1 lbs. Mn/acre at the first sign of the deficiency symptom. In severe cases of Mn deficiency, repeated sprays of Mn fertilizer are necessary. Rutgers NJAES has several fact sheets on correction of Mn deficiency. On the finer textured soils of northern New Jersey, Mn deficiency is not common.

Zinc deficiency occasionally occurs on corn, pecans, and peach trees. High soil pH decreases Zn availability. Applications of Zn fertilizer to soil will generally correct a Zn deficiency for several years.

Molybdenum is not part of a regular soil fertility test, but it should be noted that soil pH has a major influence on Mo availability; increasing soil pH increases Mo availability. Legumes need Mo to carry out biological N fixation, and in general these crops grow best at higher soil pH levels. Since very little Mo fertilizer is needed, Mo fertilizer may be applied as a seed treatment before planting.

Alternate Soil Test Laboratories

During this time period while the Rutgers Soil Test Laboratory is closed, soil testing services are still available at other Land Grant Universities and some private labs. When choosing an alternate lab, we strongly recommend that it be one that uses the Mehlich-3 soil test method; that is, the same as used at Rutgers. This is important since, Rutgers Cooperative Extension Agents are best prepared to provide interpretation and guidance for the Mehilch-3 soil test, which was designed and developed for soil fertility testing on soils of the Eastern USA. The University of Delaware and Penn State University both use the Mehlich-3 method; however, they express the results in units differently than the Rutgers Soil

Test Report. For example, Penn State reports soil tests for P and K in ppm whereas Rutgers reports these in terms of lbs./acre. A simple conversion of ppm X 2 converts these values to lbs./acre. But even without doing the math conversions, the soil fertility categories as described as “below optimum”, “optimum”, or “above optimum” have very similar interpretations to that provided by Rutgers Cooperative Extension. The University of Delaware Soil Testing Lab provides macronutrient data in “Fertility Index Values” as a relative expression of optimum nutrient test level.

References

The Rutgers New Jersey Agriculture Experiment Station contains numerous publications related to the above discussion. After finding the website https://njaes.rutgers.edu/pubs/, enter search terms for specific crops, liming, nutrient removal values, for the subject of interest.

Monitor Rutgers Soil Testing Lab’s website for updates on operating status.
https://njaes.rutgers.edu/soil-testing-lab/