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INSIDE

Understanding Soil Test Results: Soil Texture, Soil pH, and Buffer pH

Daniel Kluchinski, Mercer County Agricultural Agent and Joseph R. Heckman, Ph.D., Soil Fertility

A previous issue of the Organic *Plant and Pest Advisory* newsletter presented introductory information on soil testing. Soil testing is the most accurate way to determine soil pH, nutrient or fertility and organic matter levels. This information is the essential starting point for organic or conventional soil fertility management, whether initially building soil fertility or evaluating current methods in use.

As previously discussed, samples must be properly taken to ensure that a representative sample is being sent to a soil testing laboratory. Once analyzed, the lab provides the client information on the various soil parameters and may provide recommendations for limestone and fertilizers. Among soil testing labs, the type of information presented, the presentation method (numerical, graphically, qualitatively) and the recommendations provided often vary. However, the most commonly reported information includes soil texture, pH, and organic matter and fertility levels. A brief description of soil texture, pH and buffer pH are discussed below.

Soil Texture

Soil texture refers to the relative amounts of sand, silt and clay in a soil. These three particles are classified by size: sand [(2 to 0.5 millimeters (mm)], silt (0.05 to 0.002 mm), and clay (0.002 mm or less). Mechanical separation and calculation of the percentage of sand, silt and clay particles can be used to determine soil texture. Depending on the percentage of each particle size in a particular soil, the soil is classified in one of 12 specific textural classes. With some training, soil texture can also be determined by feel method, or how the particles feel when the moist soil is rubbed between the index finger and thumb. The Rutgers Soil Testing laboratory uses this method to determine texture and classifies texture into four broad categories: loamy sand, sandy loam, loam and silt loam.

Soil texture influences water holding capacity, internal drainage, ease of compaction, aeration, cation exchange capacity (CEC) or nutrient holding capacity, and limestone and fertilizer rate and application timing. Soil texture cannot be changed but rather soil amendments are used to improve or enhance the qualities inherent

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to the soil texture. For example, a sandy loam textured soil drains quickly and may be droughty, and therefore requires frequent irrigation. Addition of organic materials increases organic matter levels, which act like a sponge that holds water, thereby increasing water holding capacity. The soil organic matter is not a part of texture, but does modify the behavior of a given texture. Thus, increasing organic matter in this sandy loam soil, makes the soil behave more like a loam.

pH

pH is a measure of soil acidity or alkalinity, and is measured on a scale of 0 to 14, with 7 being neutral. It is important to understand that a soil pH measurement only indicates the concentration of active acidity in the soil solution. Total acidity represents the active acidity in the solution plus the amount of exchangeable acid cations (positively charged ions such as hydrogen (H^+) and aluminum (Al^{+3}) held on clay and organic matter.

Most vegetables, grains, turf, trees, and shrubs optimally produce at a slightly acid pH (6.2 to 6.5); plants such as potatoes and ornamental ericaceous or "acid loving" plants prefer a soil pH range of 4.5-5.5; and plants such as alfalfa and cabbage prefer pH in the 6.5 to 7.0 range. Acidity can be reduced (pH raised) through the use of limestone, or pH lowered by applying acidifying organic materials or elemental sulfur-containing amendments.

A soil's lime requirement can be determined using several methods. One, utilized by the Rutgers Soil Testing Laboratory, is to determine soil texture and soil pH, then use tables appropriate for the crop to be grown to determine the lime requirement. A soil's lime requirement depends on the total acidity that must be neutralized to raise pH to the desired level or target pH. For the purpose of lime recommendations, this method estimates total acidity from soil texture plus soil pH.

Buffer pH

Total acidity can be measured directly by a laboratory procedure

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What Does the Atmosphere Feed Your Crops?

Reprinted from Agri-Briefs Agronomic News Items, Summer 2000, No. 1, Potash & Phosphate Institute.

Our atmosphere is changing. Industrialized society has produced rising levels of carbon dioxide, ozone, and nitrogen oxides. Sulfur dioxide emissions may have stabilized, but considerable amounts are still transferred in the air, particularly in the northeast states.

What do these substances do to your crops? Do they help, or do they harm?

Carbon dioxide, worrisome for its role as a greenhouse gas, is the biggest source of nutrients for all plants. More than 90 percent of plant dry matter is made up of the carbon and oxygen it supplies. Numerous studies indicate that the elevated levels expected in the future are likely to stimulate plant productivity.

Ground level ozone, on the other hand, can hurt your crop. Near urban areas, crops frequently show symptoms of ozone injury. Increasing levels of carbon dioxide may not do much more than counterbalance the increasing levels of ozone.

Across the eastern Corn Belt, sulfur dioxide in the air can supply substantial amounts of the plant nutrient sulfur. Plant leaves can absorb it through their stomates as a gas or through their roots after rain washes it into the soil as sulfate. The soil does not hold sulfur well, though, and crops like alfalfa, which remove a lot of it, can still show deficiencies.

In some areas, sulfur dioxide may be concentrated enough to cause stress to plants. Recent research in India showed that nutrient-deficient soybeans were particularly susceptible, while those grown with balanced levels of nitrogen, phosphorous and potassium tolerated stress better. Potassium protects against ozone as well by increasing leaf levels of antioxidants such as ascorbic acid.

Nitrogen can be delivered through the air just like sulfur. Across most of the Corn Belt, 5 to 8 pounds per acre fall with the rain each year. Ammonia that volatizes from livestock operations, manure storages, and fields can be absorbed as a gas by plant leaves. Leaves also rapidly take up oxides of nitrogen that are emitted from the soil. In fact, a recent study in Ontario found that turf fertilized with nitrogen took up nitrogen oxides faster than unfertilized turf.

In some areas near the ocean coasts, the rain delivers as much as 28 pounds of chloride per acre each year. Away from those areas, however, chloride deposition is negligible. Rainfall delivers only very small amounts of calcium, magnesium, potassium, and phosphorus – not enough to be significant to the nutrition of most crops.

Deposition varies greatly from one place to another and from year to year. The National Atmospheric Deposition Program, through its nationwide network of precipitation monitoring sites, provides useful maps showing the distribution of nutrients delivered by rain each year. Their website, http://nadp.sws.uiuc.edu/, gives full public access to the data.

Your nutrient management plan is not complete if it doesn't consider what comes from the air.

Submitted by Joseph Heckman, Ph.D., Soil Fertility. ❑

A Drip Irrigation Management Example for Vegetables

Jack Rabin, Assistant Director, New Jersey Agricultural Experiment Station

Before soils are half depleted of their available soil water, irrigation wetting to the proper soil rooting depth (which varies by crop) is recommended. For example, wetting soil to 12 inches for shallow rooted crops needs from 1/3 inch of water on coarse sandy loam soils to 3/4 inch on loams. This affects how many hours the drip system should run. The *Rutgers Commercial Vegetable Production Recommendations* has tables to simplify calculations.

Drip emitter rates vary. A typical 0.5 gpm/100 row ft drip line on 5 ft row centers is about 8,500 row ft/acre and uses 42.5 gpm (2,550 gph).

One acre inch of irrigation water is 27,150 gallons. Using the above example of 0.5 gpm drip line we can calculate the gallons needed and run time.

27,150 g/acre inch x .33 inch = 8,960 g/acre needed per irrigation to irrigate sandy soils and 20,363 g/acre (27,150 g/acre inch x .75 inch) to wet loam soils to 12 inch depth.

8,960 g/acre ÷ 2,550 gph emitted = 3.5 minimum hours run time for 1/3 inch irrigation. More frequent irrigations of less duration will not wet soil to desired rooting depth.

During peak summer growth with no rainfall, the crop soils will need at least 1.4 inches/week (0.2 inch/day) of water. If 3.5 hours delivers .33 inch, then it requires a minimum of about 15 hours weekly run time to deliver 1.4 inches. For more convenient management, this could be done with 5 hours on alternate days. Check soil by feel or with tensiometers to adjust irrigation run times as needed.

Generally, when drip irrigating New Jersey coarse soils, we do not consider infiltration rates. Do not over-wet (i.e., use excessive run times) on clay or compacted soils or if there is risk of Phytophthora blight.

Resources: 1999 Rutgers Commercial Vegetable Production Recommendations, pages 38-39 and Knott's Handbook for Vegetable Growers, 4th Ed., pp. 219-266 and 511-512. ❑

Adding Value to Farm Products:

Postharvest Handling Temperature Management

Jack Rabin, Assistant Director, New Jersey Agricultural Experiment Station

Trying to get consistently good prices and repeat sales from buyers is a challenge to growers. This is difficult for raw harvested perishable fruits and vegetables. How do you distinguish the quality of your crop from other growers? One overlooked method is adopting the best postharvest handling methods for your crops. And the single most important method is temperature management.

Good temperature management extends the marketable shelf like of perishable crops, and keeps them appealing to your customers, and your customers' customers, for a longer sales period. It is not just cosmetic. Reducing postharvest losses increases the amount sold.

Crops are living, breathing (respiration) things. The second they are picked, they begin to die and decline in quality. The higher their temperature and respiration rate at harvest, the faster they die and become unsaleable.

Every perishable harvested crop has an optimum temperature to hold it for extending quality and shelflife. That best temperature is the lowest safe temperature before chilling injury. Individual crops have different preferred temperatures and also different preferred methods for getting to that temperature. The faster you reduce temperature, and the closer you get it near the lowest safe temperature, the longer your marketable shelflife.

These temperatures are published each year in the *Rutgers Commercial Vegetable or Fruit Production Recommendations*. For crops with very high respiration (heavy breathing rates) like asparagus, sweet corn, or peas, rapid cooling to as close to 32°F as possible, using a wet cooling method like crushed ice, is essential to successful marketing. Strawberries also require rapid cooling to near 32°F, but without any free moisture on the fruit (though relative humidity must be kept high to avoid desiccation). So, refrigeration is needed to market strawberries.

For many kinds of summer cucurbit or solanceous fruiting vegetable crops like eggplant, pepper, or summer squash, 50°F is a good target refrigeration temperature, with no free moisture from ice. Snap beans do best held a little cooler, at 45°F to 50°F, and muskmelons need it lower yet, about 35°F to 40°F in order to protect marketability and keep customers satisfied.

See Temperature Management on page 7

"Blackbirds" and Agriculture

Janet L. Bucknall, Wildlife Biologist and State Director, USDA APHIS Wildlife Services

The term "blackbird" refers to a diverse group of about ten North American bird species. Two blackbirds are common in New Jersey: red-winged blackbirds and common grackles. Crows and starlings are not classified as blackbirds, but are also commonly involved in agricultural damage situations. Although crows and blackbirds are protected by the Migratory Bird Treaty Act and State law, a "Depredation Order" exists at the Federal and State levels that enables the farmer to control these species to reduce damage without a permit. Starlings are not afforded Federal or State protection, and may also be taken without a permit. Prior to initiating a control program, it is advisable to consult local and county laws to ensure compliance with firearm discharge, animal protection, and noise ordinances.

Corn loss to blackbirds is currently the greatest economic loss by birds to any North American crop. In 1990, red-wings destroyed over 360,000 tons of field corn in the U.S.; although this represented only 1% of the national production, localized losses were severe to many farmers. Damage is typically concentrated in farm areas that are within 5 miles of a wetland roost site.

Starlings often congregate in winter roosts associated with farm buildings and barns. Thousands of starlings may seriously impact farm operations through feed consumption (individual starlings may consume up to 50% of their body weight in grain each day) and contamination.

As with every wildlife damage problem, the most effective control program is one that integrates a number of practical, effective, and legal techniques. Blackbird damage control programs on the farm typically consist of modification of certain farm practices, harassment, and removal of birds through lethal means. Success of the program will depend on the flexible and diligent application of techniques by the farm operator, and in some cases, coordination of damage control programs among neighboring farmers.

To reduce red-winged blackbird damage to field corn, modification of farm practices may include use of bird-resistant varieties of corn, insect control, and alteration of planting and harvest schedules. To reduce starling damage in farm buildings, clean up spilled grain, store grain in bird-proof facilities, use feed forms not appealing to starlings, and adjust feeding schedules (starlings prefer to feed early-mid morning).

Harassment of blackbirds and starlings can be accomplished through use of pyrotechnics, propane cannons (State permit needed, 908-735-8793), and use of Avitrol (R). Initiate harassment programs as early as bird presence is detected, and as necessary to prohibit the birds from developing strong affiliations to your farm. Propane cannons work best when they are moved periodically, and shut down when birds are not present. Prior to use of Avitrol (R), contact the NJ Bureau of Pesticide Control (609-984-6901) to guarantee its registration, and comply with all pesticide use regulations.

Removal of birds usually is accomplished through shooting. As noted earlier, no Federal or State permit is needed, but check your local laws to guarantee compliance with municipal and county statutes. Shooting should be employed as a reinforcement to harassment.

For more detailed advice on reducing blackbird and starling damage on your farm, contact the USDA APHIS Wildlife Services. 140-C Locust Grove Road, Pittstown, NJ 08867, (908) 735-5654 and request leaflets entitled:

Starling Control at Feedlots
Control of Blackbird, Starling, and Crow Damage to Corn and Other Crops
Control of Blackbird, Starling and Crow Roosts
Bird Control Devices, Sources of Supply
Pyrotechnics for Bird Control

Farmers Needed for Wildlife Damage Study

David Drake, Ph.D., Wildlife Management

Rutgers Cooperative Extension is currently conducting a study to assess damage to a variety of agricultural crops. We have put up roughly 70 exclosures so far and expect to put up another 30 - 50. However, we need to locate farmers who are experiencing wildlife damage (ranging from some to a lot) to their crops. We are looking for farmers who are currently growing strawberries, apples, leafy vegetables, and nursery stock. We will be looking for other fruit and vegetable crops, forage crops, and grains as they are nearing harvest. The USDA assessment techniques can only be used when the crop is mature and nearing harvest or actually being harvested. You cannot be using fencing or any other type of crop protection, as this will bias our results. We will not interfere with any farming practices. We need to assess damage from all types of wildlife (i.e. groundhogs) and not just deer and geese. Please contact your county agricultural agent about participating in the study. ❑

Impact of Environmental Conditions in the Landscape and Garden on Plant Health

Clare S. Liptak, Senior Program Coordinator, RCE Resource Center, and Ann B. Gould, Ph.D., Plant Pathology

Environmental conditions, such as temperature, moisture, aspect, and planting site characteristics, play a large role in plant health and the development of disease and insect problems. In this article*, we examine the impact of temperature and sunlight on plant vigor in a landscape and garden setting.

Effect of Temperature: Acclimatization, Hardiness, and Microclimate

Plants become **acclimated** to winter weather in autumn when the days are short and the weather is cool. Loss of winter hardiness due to warm winter weather is called deacclimatization. Most winter injury occurs after plants have lost hardiness due to unseasonably warm weather. Once deacclimated, temperatures they would have easily tolerated had they been hardy can injure plants. For example, the weather was unseasonably warm during January and early February of 1999. This caused a loss of winter hardiness in many landscape plants throughout New Jersey, which then sustained winter injury in late February when the weather returned to normally cold temperatures. Winter injury also occurs when plants are pruned between mid-July and mid-October. Pruning this late in the growing season stimulates new growth that will not be hardy by the time normal fall and winter weather arrives.

A **hardiness zone** corresponds to the lowest winter temperature normal for that area. Hardiness zones in New Jersey are zone 5 (low winter temperatures of -10 to -15°F) in northwestern New Jersey, zone 7 (5 to 0°F) in the shore areas of southern New Jersey, and zone 6 (0 to -10°F) in all the areas in between. Gardeners can check with their local garden center or the Rutgers Cooperative Extension office in their county to determine the hardiness zone for their area. Choosing plants appropriate for a particular hardiness zone is not a guarantee of plant survival; gardeners must be aware of **microclimates**. These small environments may differ in temperature, soil moisture, and the quantity or quality of light compared to the area as a whole. Microclimates are due to the influence of features such as nearby buildings, walls or fences, paved areas, land formations, and bodies of water. An example of a microclimate is a region in a landscape that is warmed by the heat reflected from white siding on a home or by large expanses of window glass on an office building.

Many microclimates may exist in the average landscape. Planting sites that are dry due to large roof overhangs will require drip irrigation systems unless landscape plants tolerant of dry soils are chosen. Low areas in the landscape where cold air settles are difficult microclimates for plants that bloom in early spring, such as magnolias. Plants placed on south facing slopes will start to grow earlier in the spring than the same plants placed on north-facing slopes. The tender growth of plants facing south is often injured by normal early spring temperatures. Temperatures are usually milder,

See Microclimates on page 6

Wildlife Management Twilight Meeting

Raymond J. Samulis, Burlington County Agricultural Agent

It comes as no surprise to farmers that wildlife damage to New Jersey farms is on the rise. Natural pest populations are increasing and urbanization has greatly reduced normal animal habitats. Deer, geese, swans, ground hogs, and grackles all raise havoc and cause severe economic losses. Rutgers Cooperative Extension of Burlington County has developed a Wildlife Management Twilight Meeting to share the latest techniques and devices to better deal with wildlife problems. The Rutgers Wildlife Damage Specialist, as well as state and local Fish and Game personnel will give demonstrations. This Twilight Program will be held the evening of June 19, 2000, at 7:00 p.m. on a farm just outside Mt. Holly. While this program was designed for Burlington County farmers, growers from other counties with severe wildlife problems or just interested in wildlife damage are welcome to attend. Out of county growers can call our office at (609) 265-5050 for directions.

Growers attending the meeting can anticipate learning the most comprehensive wildlife damage information available, enjoy refreshments, and direct discussions with knowledgeable experts and growers experiencing the same problems as you are. Why not come out and experience the latest in an ongoing struggle? ❑

Points to keep in mind regarding temperature and landscape plantings include:

- ✔ Compared to rural areas, urban environments have greater temperature fluctuations due to shelter from winds and re-radiated heat.
- ✔ Choose plants that are hardy in your zone or the next lower zone.
- ✔ Plants that are hardy in the ground in your area may not be hardy in containers. The roots in containers, even large ones, are exposed to ambient temperatures without the insulating effects of soil.

MICROCLIMATES FROM PAGE 5

however, by the time plants facing north begin to develop, so this type of early spring frost injury may not occur. The effects of microclimates are subtle but significant. For example, because of the heat generated by paved areas, a population of spider mites will increase much more quickly in a ground cover juniper planted near a sidewalk or driveway compared to similar junipers growing in the center of the planting.

Some damage from cold winter temperatures doesn't appear until the following spring or summer when twig dieback may occur or buds fail to develop. For example, buds may appear to develop normally early in the growing season, but then die during the first dry period of the spring or summer. In such cases, the sapwood in the trunks and branches of affected trees and shrubs was injured or killed due to cold winter temperatures. These plants are thus unable to deliver sufficient water to the canopy. Some landscape plants, such as balsam fir, don't do well in New Jersey; even though they tolerate our winters, summers in the state are too hot.

Sun and Shade

Many flowering plants, such as roses, require full sun (defined as 6 or more hours of direct sun per day) for their best growth and flower display. Experienced gardeners select landscape plants while keeping in mind the expressions "don't fight the site" and "right plant, right place." Although planting sites can be modified to some extent, choosing a plant to match the site results in a healthy, attractive plant that requires less care.

For example, flowering dogwood (*Cornus florida*) is a native tree that is commonly found in the understory layer of a forest. The tree can do well in the sun, however, if it is placed in well-drained soil with adequate moisture. If soil moisture is limited due to drought or competition from turf or ground covers, the tree is more susceptible to the dogwood borer, a serious pest. Many native flowering dogwoods in New Jersey eventually die of borer damage because they are stressed by unfavorable growing conditions. Other small flowering trees such as Kousa dogwood (*C. Kousa*), Kousa hybrids, crabapples, flowering cherries, magnolias, hawthorns, Carolina silverbell, and tree lilac are also suitable choices for sunny planting sites.

Trees that require full sun will be stressed when grown in a shady planting site. Since their leaves are not exposed to enough sunlight to make the food they need (carbohydrates or starch), their resistance to insect and disease problems declines. Bark beetles, browsing mammals, fungal pathogens, and defoliating insects will be more likely to attack such plants.

Gardeners can take advantage of the varying qualities and effects of sunlight throughout the day. Morning sun will dry plant foliage that may have been covered with dew during the night. If a gardener has no planting sites with full sun for roses, for example, morning sun is the next best choice. Keeping foliage as dry as possible helps reduce problems with black spot, a fungal disease of roses. Also, afternoon sun is more stressful than morning sun for many plants.

**This article is reprinted from Part I of a four part series in the Landscape, Nursery & Turf edition of the Plant & Pest Advisory. To see the other parts (II: Moisture Extremes, May 4th issue; III: Soil Characteristics, May 18th issue; and IV: Allelopathy, Planting & Deadheading, June 1st issue) visit our website at: http://www.rce.rutgers.edu/pubs/plantandpestadvisory/2000/landscape.html or for reprints write to: Plant & Pest Advisory, 18 College Farm Road, Cook College, New Brunswick, NJ 08901-8551.* ❑

Produce Growers Directory Update

Pegi Ballister-Howells, New Jersey Farm Bureau

New Jersey Farm Bureau, with the help of a Jersey Fresh grant, is in the process of updating the 1995 Produce Growers Directory. The new format will be internet accessible and will be available on disk. Hard copy can be printed and kept in a three-ring binder. Many new categories have been added. We want to update existing entries, so all farmers must fill out the new form even if you are already in the existing edition. County Agents will be assisting with the mailing of the forms and Farm Bureau will mail out to those members with an interest in produce. If you do not receive a form, and wish to be included in the directory, contact the Farmhouse at 609-393-7163. This buyers' guide has been very well received in the past and is an excellent marketing tool for your fruit and vegetable products. The more farms listed, the more essential the resource will become to potential buyers. There is no charge to be included in the directory. ❑

TEMPERATURE MANAGEMENT FROM PAGE 3

Finally, do not overlook preharvest factors that affect shelflife:

- ✔ Harvest in early mornings before field heat (thus respiration) builds, requiring more energy and time to cool items.
- ✔ Pick into clean containers that will not scratch and injure produce.
- ✔ Eliminate preharvest defects in the field or at packing.
- ✔ Keep items in the shade between picking and packing.
- ✔ Don't haul over the road in uncovered trucks.
- ✔ Don't allow road heat and axle heat to come up through loaded products.

Next month I'll write about tomatoes, which have unique requirements depending on when harvested. ❑

BUFFER PH FROM PAGE 2

called titration, referred to as soil buffer pH. Buffer pH is a measurement used to determine lime requirement and should not be confused with soil pH. Using this method, there is no need to determine soil texture to estimate lime requirement. Rather, a formula that factors in buffer pH, initial soil pH and target pH is used. Both methods are valuable and provide useful information. However, since methods vary from each lab, one cannot easily utilize one set of data to provide recommendations developed for use with another method.

The recommendations for liming New Jersey soils are reported in pounds of calcium carbonate equivalent per acre (lb CCE/A). Pure calcium carbonate ($CaCO_3$) has a CCE of 100% and is the standard against which all liming materials are measured. Since the CCE of liming materials available may vary from 40 to 179% CCE, the amount of liming material needed to supply the given quantity of CCE will vary considerably. Rutgers Cooperative Extension Fact Sheets (FS902, FS903 and FS904) provide a calculation table for determining the amount of liming material that should be applied to meet the CCE needed. Limestone can also be a source of calcium and magnesium. In a future article we will discuss calcium and magnesium fertility, and limestone material selection.

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