This informational packet was provided by Jean Reeder, PhD, Consultant, CSU Soil Testing Lab and Master Gardener Instructor, as a courtesy to the Estes Valley Community Garden (EVCG) and its Gardeners, following her presentation on May 3, 2016 at the Estes Park Senior Center.

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Thank you.

Estes Valley Community Garden Board

Building Soil Health

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1. See www.cmg.colostate.edu for CSU Extension GardenNotes and Fact Sheets on various gardening topics.

2. The most common inciting factor to unhealthy plants in Colorado landscapes is the condition of the soil. Over 80% of plant problems in Colorado landscapes are related to soil conditions.

3. Soil is the fundamental component of any landscape and is crucial to plant health. Soil provides plants with:
    a. Nutrients
    b. Water
    c. Oxygen needed for root metabolic processes
    d. If the soil isn't healthy, plants won't be healthy

4. Healthy soil is a living ecosystem, teaming with life (microorganisms, insects, worms, etc.)

5. To build soil health, manage your soil to create a healthy environment for both beneficial soil organisms and plant roots:
    a. Reduce/avoid soil compaction to maintain good soil porosity
    b. Don't use pesticides unnecessarily
    c. Add organic amendments properly
    d. Add fertilizers properly
    e. Irrigate properly

6. Soil compaction: a reduction in large pore space
    a. Water movement into and through the soil slows down
    b. Water dominates pore space; soil oxygen levels decline
    c. Results in shallower, smaller rooting volume (stressed plants)
7. Causes of soil compaction
    a. Construction activities (digging, mixing, driving on the soil)
    b. Foot traffic
    c. Rain falling on bare soil
8. Ways to decrease soil compaction
    a. Add high quality organic matter
        i. Glues soil particles into larger aggregates, creating pore space
        ii. Feeds beneficial soil organisms
    b. Manage traffic flow
        i. Create foot paths
        ii. Don't drive on the soil
        iii. Stay off of wet ground
    c. Use mulch to cover the soil: 3-4" depth minimizes compaction forces of foot traffic and raindrop impact
    d. Avoid excessive tillage in the vegetable and annual flower gardens
    e. Aerate turf areas heavily (plugs at 2" centers"

9. Pesticides: don't use unnecessarily
    a. Non-selective types can kill off "good guys" as well as the "bad guys"
    b. Read the label: use the right product, the right amount, and the right timing of application

c. Many management practices can minimize pest problems (weeds, insects, diseases, grazers)
    i. Fencing
    ii. Proper irrigation, proper additions of amendments and fertilizers
    iii. Vegetable garden: rotate crops, row covers, cover crops

10. Applying organic amendments
    a. Benefits
        i. Builds aggregation/porosity
        ii. Increases water and nutrient holding capacities
    b. Problems
        i. Organic amendments e.g. compost are usually salty and highly variable in quality
        ii. Manure-based composts are generally more salty than plant-based composts
    c. CSU recommended annual application rate:
        i. No more than 1" of manure-based compost, or 2-3" of plant-based compost
        ii. Till into the top 6-8 " of the soil
        iii. Use proportionally less if can't till 6-8" deep into the soil
        iv. Cut back after the first 3 years

11. Applying fertilizers
    a. Fertilizer needs are best determined by a soil test
    b. Add fertilizer only if a nutrient is deficient
    c. Add only what is needed, not more.
    d. Different types of plants have different nutrient requirements
        i. Vegetables: high nutrient requirements
        ii. Flowers, trees, shrubs: medium to low nutrient requirements
        iii. Evergreens, xerics/natives: low nutrient requirements
        iv. Plants don't thrive with the wrong levels of nutrients
    e. Negative consequences of over-fertilizing
        i. Salt buildup in the soil (can harm plants)
        ii. Excess nutrient buildup in the soil, well beyond plant needs
            1. Encourages weeds
            2. Is a potential source of pollution of the environment
            3. Imbalance in nutrient ratios: too much of one nutrient can interfere with uptake of another nutrient
            4. High levels of plant-available nitrogen
                a. Inhibits flowering and fruit set
                b. Increases disease and insect problems (e.g. powdery mildew, aphids)

12. Irrigating properly
    a. Keep the primary root zone well hydrated and well aerated
    b. Minimize loss of water from runoff or leaching below the root zone during irrigation
    c. Water as infrequently as possible (maximize the time to drain excess water from soil pores and recharge oxygen into the soil)
    d. Improper irrigation (plants are too wet, too dry, irregularly watered) is a major cause of insect, disease, and weed problems.

13. Gravelly, coarse-textured mountain soils
    a. Benefit from the addition of high quality organic amendments
        i. Adds nutrients

ii. Increases water and nutrient holding capacities
iii. CSU recommended application rate: 25% by volume
1. 1" organic amendment tilled 4" deep, or
2. 2" organic amendment tilled 4" deep

b. When these soils are not amended
i. Accept less than optimal growth, and increased maintenance (irrigation, fertilization)
ii. Focus on plant selection: select plants that tolerate restricted root spread, drought conditions and low fertility
iii. Avoid crowding plants (competition for limited soil resources)
iv. Use small transplants rather than large transplants or seed
v. Organic mulch can improve soil over time as the mulch decomposes

14. Raised bed gardening: <u>selecting a soil for a raised bed</u>
a. Bulk and bagged soils are <u>not regulated by law</u>; the quality varies widely. Ask for a soil test report, or consider getting the soil tested yourself.
b. Bulk soil criteria:
i. pH less than 8 (ideal pH range is 6 to 7.2)
ii. No salinity issues (Electrical conductivity is less than 2 mmhos/cm)
iii. Loamy texture (clay content less than 30%)
iv. Organic matter content about 4-5%
1. Avoid planting mixes with more than 25% compost added; these can be very salty and contain very high levels of plant-available nutrients
v. Questions to ask the vendor
1. Where did this soil come from
2. How old is this pile
3. What has been added to this soil (manure? Compost?)
c. Bagged "soil" products
i. A huge variety in composition and chemical quality. Can be composed of a mix of sphagnum peat moss, vermiculite or pearlite, wetting agents, forest products, ash, compost, fertilizer; occasionally contain sand or mineral soil.
ii. Are not real soil (sand/silt/clay); they are mostly an organic amendment
iii. Many are very salty
iv. Variation in chemical composition and salinity level can vary significantly for the same brand product bag-to-bag
v. Dilute at least 1:4 with *in situ* soil
d. To avoid a textural interface at the bottom of a raised bed, dig up the *in situ* soil beneath the raised bed, mix new soil with the *in situ* soil, then fill the raised bed with the new soil. This helps water drain from the raised bed into the soil below without water ponding at the bottom of the raised bed.

15. <u>Selecting a potting soil</u>
a. Potting soils are not regulated by law
i. Quality varies widely brand-to-brand, and even bag-to-bag of the same brand product
ii. Read the bag, what does the potting soil contain?
b. Basic potting mix: sphagnum peat moss, perlite or vermiculate, sometimes pumice.
i. Basic potting mix does not contain nutrients
c. Potting mixes with compost, manure or fertilizers added
i. Can be very salty and overloaded with nutrients
ii. Run water through the material several times before planting (to rinse excess salts out of the potting soil)

February 20, 2016

Soil Testing –FAQs

1. **Why should I have my soil tested?**
   A soil test is the best way to check the growing potential of your garden. The *CSU Soil Testing Laboratory's "routine" Garden and Landscape test takes the guess work out of your garden's growing potential. It will guide you in deciding which nutrients are deficient and sometimes more importantly, which nutrients you have too much of. Over-fertilizing is a common gardening problem. It is not only expensive, but also may harm your garden's production and our environment. The soil test will also tell you whether your soil's organic matter content is sufficient to support healthy plant growth; whether your soil is too salty; or whether your soil's pH is acceptable for the plants you want to grow.*

2. **Where can I have my soil tested?**
   The CSU Soil Testing Lab is located in the Natural and Environmental Sciences Building, Room A319, Colorado State University, Fort Collins CO. (Telephone: 970-491-5061). Soil sampling kits can be picked up at various Colorado Front Range nurseries and County Extension Offices, or at the CSU Soil Testing Lab. (See list of locations on the Lab's website: www.soiltestinglab.colostate.edu). A sampling kit consists of: 1 sample bottle + 1 submission form and sampling instructions + 1 USPS mailer (optional).

   Alternatively, a submission form and sampling instructions can be downloaded from the Lab's website, and the sample can be collected in a zipper-lock plastic bag. Soil samples either can be dropped off at the Lab, or mailed to the Lab (address on the back of this page).

3. **How much does it cost?**
   The "routine" Garden and Landscape soil test costs $35.00 ($48.00 for compost or manure samples). You can pay when submitting your sample, or the lab can bill you.

   Why can't I just buy a home soil testing kit? They're cheaper.
   Home soil test kits have questionable value. Most home test kits were designed for acidic soils and have questionable accuracy on the alkaline soils found along Colorado's Front Range. At best, home soil test procedures give ballpark readings, but are not precise enough to accurately determine soil pH or nutrient levels.

4. **What information do I get with a soil test?**
   The CSU Soil Testing Lab's soil test provides pH, salinity, lime estimate, texture estimate, organic matter content, and plant-available N, P, K, iron, zinc, manganese, copper and boron. Fertilizer recommendations, data interpretations, and management suggestions are also provided.

5. **When should I sample?**
   Soil samples can be collected any time of the year, as long as the ground is not frozen. Do not soil sample within 30 days of an application of nitrogen fertilizer, compost, or manure.

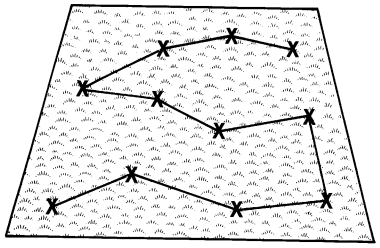
6. **How many samples should I collect?**
   One soil sample should represent a uniform area consisting of land that is similar in slope, drainage, texture, or other characteristics that make the soil properties uniform within the area. Submit a separate soil sample for each area that receives different fertilizer, amendments, and/or soil management treatments. For example, vegetable garden areas are managed differently from lawns, so the two should be sampled separately. Different garden beds, or different lawn areas that receive differing amounts of fertilizers, soil amendments or irrigation, should also be sampled separately.

7. **How often should I soil sample?**

The first time you test your soil establishes base line soil properties. Soil testing should be repeated every 4 or 5 years to re-establish the base line, or, when dramatic changes have been made to the soil (e.g. addition of large quantities of manure or compost), or, when plant problems develop and a soil problem is suspected.

8. **How do I collect a soil sample properly?**

Use a clean, rust-free trowel, spade, soil tube, or soil auger to collect your soil sample. Each sample should be a composite of 5 to 15 sub-samples (depending on the size of the area), collected randomly throughout the chosen area. Collect these sub-samples to a depth of 6 inches (do not include thatch layer in samples from turf areas), Combine subsamples in a clean plastic container. Try to dig straight down, rather than at an angle, so that equal amounts of soil are collected at each depth increment. Try to collect roughly the same amount of soil from each sampling area.



AREA TO BE SAMPLED
(x's are random sample spots)

Mix the sub-samples together thoroughly. Remove rocks, plant debris and break up clods to pea-size or smaller. Remove about 2 cups of soil; spread on paper towels and air-dry (do not oven dry). Return the rest of the soil to the landscape. Place the dry soil sample into the CSU soil sample container (preferred), or a zipper-seal plastic bag. Seal the container and label the sample with name, address, and location of the sample (for example "Vegetable Garden", "Lawn1", "Lawn2", etc.

If multiple samples are being submitted for analysis, including a map of your sampling procedure would be helpful in interpreting the laboratory analyses.

Complete the sample submission form as completely as possible. Use a separate form for each soil sample. Include the submission form(s) with the soil sample(s). Samples either can be dropped off at the lab, or, mailed to the lab:

Soil Water and Plant Testing Laboratory
Colorado State University
Room A319 NESB
Fort Collins CO 80523-1120

For submittal by UPS or FedEx, please use:

Soil, Water and Plant Testing Laboratory
Colorado State University
200 West Lake Street
Fort Collins CO 80523-1120

Please keep samples cool before mailing. If samples heat up, the nitrogen readings can change dramatically. Submit samples to the lab as soon as possible after sampling.

9. **How long does it take?**

Test results are sent to the customer within 2 weeks of the lab's receiving the sample.

10. **Can I get water and plant samples tested too?** *Yes. Information on plant and water sample testing can be found on the website: www.soiltestinglab.colostate.edu.*

These 2 items were also provided at the presentation. Copies of these and other fact sheets can be obtained from Colorado State University, Cooperative Extension website at http://extension.colostate.edu/publications-2/

Fact Sheet No. 7.244
Colorado Mountain Gardening Basics

Fact Sheet No. 7.220
Gardening Series: Basics – Colorado Gardening: Challenge to Newcomers