This past winter and spring, I participated in a 12-part "Soil and Nutrient Management for Berry Crops" webinar series, a project that was funded by NE SARE (Northeast Sustainable Research and Education Program), and which was organized by Marvin Pritts (Professor of Horticulture at Cornell Univ., with a concentration in small fruit production) and Cathy Heidenreich (Extension Berry Specialist at Cornell Univ.). I found them quite valuable and informative, so I decided to share the useful / cranberry-relevant facts from these webinars as a regular part of our summer on-site cranberry trainings this year. My intention is to cover one webinar's worth of material at each of our summer sessions, in addition to our traditional pest topics.

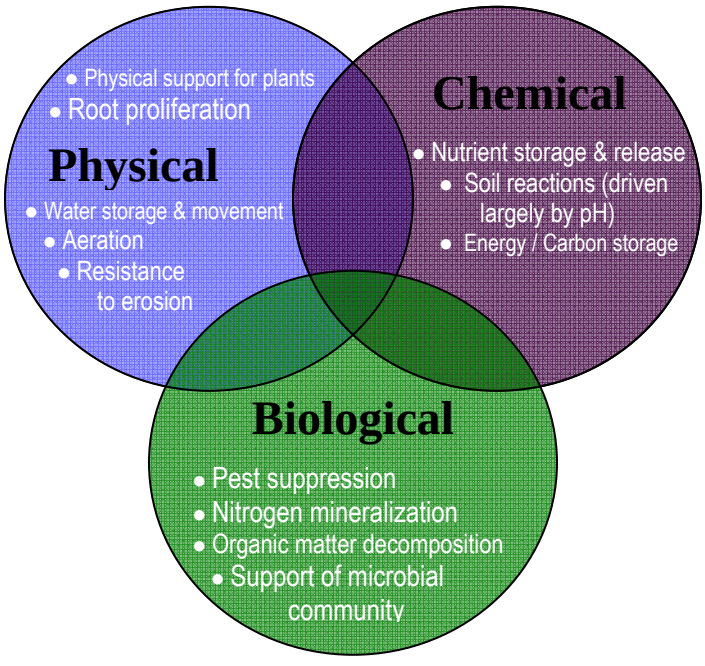
Topic #1

Introduction to Soil Management - [Oct. 7, 2011] *Dr. Harold van Es, Cornell University* [professor of soil and water management / soil physics]

- Soil types
- Soil surveys
- Physical properties of Soil
- Biological properties of Soil
- Chemical properties of Soil

KEY POINTS:

- **How does one define 'soil health?'** One good and simple definition is: The capacity of the soil to function, and in our case, proper function = the ability to produce high quantities—and high *qualities*—of our berry crop. A healthy soil should result in reduced inputs compared to an unhealthy soil.
- **Characteristics of Healthy Soils:**
  - ✓ sufficient (but not excess) nutrients
  - ✓ good tilth (relates to the aggregation structure; *good* tilth is rather like the opposite of compaction)
  - ✓ sufficient depth (for good rooting)
  - ✓ good water storage and drainage
  - ✓ free of chemicals that might harm [cranberry] plants
  - ✓ low populations of plant disease and parasitic organisms
  - ✓ high populations of beneficial organisms
  - ✓ low weed pressure
  - ✓ resistance to being degraded (compaction / erosion, etc.)
  - ✓ resilient (i.e. quick recovery from adverse events; e.g. floods, hurricanes)
- **Soil Processes (these three processes interact with one another):**



- **Not all soils are created equal.** In other words, different types of soils have, just by their nature, different 'inherent' soil qualities, and any of them can improve (or become 'worse') as a result of human management / interference. However, good site selection is nevertheless critical to successful berry management.
- **Inherent Soil Quality Properties:**
  - ✓ **Physical** → texture and stoniness, internal drainage (can be modified), soil depth or presence of barriers (can 'sometimes' be modified), and slope.
  - ✓ **Chemical** → pH, nutrients (can be modified)
  - ✓ **Biological** → organic matter content / cation exchange capacity (can be modified over the long term)
- **Soil Survey data can be obtained online at:**
  http://websoilsurvey.nrcs.usda.gov/app/homepage.htm (or google "web soil survey")
  Please Note: *Data on this site is only a measure of the **'expected'** conditions for the area of interest; still need to conduct one's own soil health test to be more site-specific and to get additional / dynamic information.*

pH (a critical component) as it relates to Nutrient Availability:

- **In general:**
  pH > 7 will mean that phosphorus, boron, copper, iron, manganese, and zinc are all less available [to plants].
  pH < 5.5 will mean that calcium, magnesium, and molybdenum are all less available [to plants].
- **Liebig's Law Of The Minimum:**
  Yield is proportional to the amount of the most limiting nutrient, whichever nutrient that may be. This is generally true, but it is important to realize that there might be a **physical** (e.g. compaction, poor drainage or aeration) or **biological** property or situation which is the cause of the limitation (It isn't always about the chemistry / i.e. not always due to nutrients or pH, for example!).

***** This point was perhaps THE take-home message for the entire webinar! *****

Poor Plant Water Availability:

- Soil water availability is mostly a function of texture, organic matter content, and rooting depth.
- Compaction may reduce root proliferation and water access by plants; can be improved (deep ripping, compost addition)
- Coarse soils are often associated with good drainage, and mild water stress can readily occur.

Soil Compaction (can be in the upper and/or deeper portions of the soil):

- Surface is crusty (runoff of water rather than soaking into the soil)
- Poor aeration
- Limited spaces for the roots (roots need pores that are greater than 0.2 mm, and a soil strength that is less than 300 psi, i.e. a naturally *softer* type of soil)
- Some things that can cause compaction: lack of organic matter additions, traffic by heavy equipment [on the beds] when they are wet, and soil settling from heavy rain

Roles of Organic Matter in Soils: *[and there are generally three 'types' of organic matter found in soils: 1) Living, 2) Dead, and 3) Very dead!]*

- 'Living' Organic Matter:
  - ✓ Soil organisms, which play important roles in making nutrients available, suppressing disease, producing plant growth-promoting hormones, creating humus, and aggregating soils. Mycorrhizae are a particularly important example in this category, especially for cranberries; defined as symbiotic non-pathogenic fungi that exist in a symbiotic relationship with the roots of higher plants. They enhance nutrient uptake (P, N, K, micronutrients) *(especially phosphorus);* they help with soil aggregation; they form a defense against pathogens; they protect plants against metal phyto-toxicity, and they enhance plant fitness (pollen quality and plant-pollinator interaction).
  - ✓ Plant roots – the second and somewhat obvious type of 'living' organic matter.
- 'Dead' Organic Matter:
  - ✓ Recently dead soil organisms and crop residues, which provide the food (energy and nutrients) needed for soil organisms to live and function. This kind is also called "active" or "particulate" organic matter.
- 'Very Dead' Organic Matter:
  - ✓ Well-decomposed organic materials, i.e. humus – Humus contains very high amounts of negative charge (holds nutrients) and has high water-holding capacity, and stores Carbon.

Summarizing Points to Remember:

- ✓ **Inherent vs. human-caused ('dynamic') soil quality**
- ✓ **Physical, Chemical and Biological** (all equal in importance)
- ✓ **Pre vs. Post-establishment** (make your 'big' soil improvements prior to planting as much as possible, but there are things you can do after the fact as well)
- ✓ **Surface soil vs. Subsoil**
- ✓ **Short-term vs. Long-term**