A good soil is like a good wine

Chantal Foulds has now heard this soil scientist from France speak four times; he's still as captivating as he was the first time, according to the author, combining stories of French culinary recipes with microbiology and chemistry. This Frenchman portrays the task of managing soil much like that of creating a good wine.

by Chantal Foulds

Claude Bourguignon hasn't invented anything new, but rather has pulled together several techniques that he uses to analyze a soil through the entire profile, not just at the soil surface.

The underlying principle to Bourguignon's approach is that the fertility of the soil rests upon it's clay-humus complex. Soil nutrients and water are retained by a complex of humus and clay particles, and linked by calcium (Ca) and iron (Fe) based compounds. The concept is not without precedent, there are references to be found in standard textbooks on soils; rarely, however, is the same emphasis placed on the subject matter as done by Bourguignon.

Soil components should be managed as a complex, according to Bourguignon, rather than as three separate items. For example, some studies done on sandy soils have shown that organic matter in the form of fresh manure, actually has a negative effect on soil properties. Bourguignon contends that for a sandy soil, clay and lime should be added along with composted manure to correctly manage the soil. Adding fresh manure deals only with one component of the complex, the organic matter. The other two components, clay and linking compounds, need to be added as well, as sandy soils are as poor in these two as with the first.

Bourguignon uses physical, chemical and biological analysis to determine a soil's state of health. Standard soil tests use many of these same processes, but what he does differently is to develop these analyses to a fuller extent. Most importantly, he extends the analysis over an entire soil profile in order to get an understanding of how the soil is evolving under cultivation.

Field Observations

The task of evaluating a soil begins by digging a one cubic metre hole in the ground. Visual observations are made of the different soil layers in relation to cultural activities and the nature of the soil. For example, do taproot species bend in response to compact layers? Are earthworms or castings present? At what depth do soil conditions appear to be anaerobic? What is the soil structure at different soil depths?

Field tests are performed at different depths in the soil profile to measure the pH, the quality of the clay-humus complex and microbial activity. The observed results are used in conjunction with laboratory analyses to come up with an overall evaluation.

Laboratory Analyses

In the laboratory, Bourguignon complements current soil testing methods by determining the type and quality of clay present in the soil. The clay type affects what percentage of the Cation Exchange Capacity (CEC) is due to the clay. (The CEC is a measurement that reflects a soils ability to retain cations, in effect a measurement of the soil's ability to retain certain nutrients). The CEC that on a soil test is that generated by the levels of organic matter and clay present in the soil. Depending on the quality of each, the CEC can also be higher or lower. For example, kaolinites have 30 m3/g (cubic metres per gram) of surface on which ions can exchange. Compare this with montmorillonites , which have almost 30 times as much surface area and the importance of the clay type in relation to a soil's nutrient conservation mechanism immediately becomes apparent.

When the CEC based on clay quality has been determined, the CEC in relation to organic matter can be calculated. Generally speaking, it will vary 0.5 to 5 CEC for every 1% of organic matter. A good quality organic matter can mean a 10 fold increase in the CEC of the soil and consequently its ability to make soil nutrients available.

By stressing the importance of good quality clay and humus, Bourguignon maintains that it's irrelevant to measure soil nutrient availability alone, which is what appears in soil test reports. Such information only gives a picture of the nutrients available at the time the soil test was taken. It is more important to know whether the total nutrient content is adequate, and whether the clay-humus complex and microbial activity is in sufficient health to ensure mineralization of these soil nutrients. This is why he advocates measuring total soil N, P, K etc., instead of just available N, P, K etc.

Adaptability to Canadian Conditions

Bourguignon developed this soil evaluation package with the help of a pedologist for soil from France. He emphasizes the need to adapt these procedures to North American conditions. For example, some clay deposits in Quebec react differently to the soil tests. This is due to their chemical structure which results in the soils being "enrobed" rather then being "linked up" with organic matter. As a result microbial access is more difficult In these cases, attempts to calculate the CEC of the clay and organic matter would be distorted. He suggests that it would be useful for the scientific community to sort out these problems to enable a wider application of Bourguignon's soil analysis methods under Canadian conditions.