Soil Quality Management for Profitable and Sustainable Vegetable Production

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Presentation Summary

Maintaining soil quality is essential to the success of every farm. In fact, growers may have only two true resources: their know-how and good quality soil. Lacking either jeopardizes the farm's success. Farmers have many opportunities to increase their know-how, but repairing soil quality once it is severely degraded may be impossible -- it is certainly difficult, time-consuming, and costly. Because of this, successful farmers recognize that preservation of healthy, high-quality soils is essential. Soils provide the physical support, nutrients, water, and gas exchange that crops require. Soils are also home to organisms which impact crop growth. Soil factors determine the need for various inputs, thereby effecting production costs, yield, and crop quality. This presentation briefly summarizes how soil quality may be defined, evaluated, and managed.

Soil quality is defined in terms of a soil's capacity to perform basic functions. For vegetable farmers, of course, the principal function of soil is to produce a bountiful crop with few inputs.

In evaluating soil quality, the focus is on properties or processes effected by management. Soil quality is evaluated with indicators used to measure physical, chemical, and biological properties. These categories are useful, but it is important to remember that many soil properties are related. Therefore, soil should be viewed as an integrated system rather than a collection of separate parts or processes. The most useful soil quality indicators integrate the combined effects of several properties or processes.

Important physical indicators of soil quality refer to water storage and movement, soil structure, and soil or aggregate stability. Many physical indicators are related, such as the effect of soil structure on soil-water relations. Important chemical indicators include the presence and amounts of essential nutrients and other, possibly growth-inhibiting, compounds. Like biological and physical indicators, chemical indicators are often related, such as the effects of pH and CEC on nutrient availability. Biological indicators often refer to the amounts, types, and activities of soil organisms. A large, diverse, and active population of soil organisms may be the most important indicator of a healthy, high-quality soil. Yet, soil biological activity may be the most difficult indicator to satisfactorily measure and interpret.

Certain soil traits are not used to evaluate soil quality although they influence soil use or productivity. Soil texture, topsoil depth, and slope or topography are fixed, mostly unalterable soil properties which fall

into this category. However, it is important to understand inherent soil properties as they often limit what management practices can do to improve soil quality.

A number of soil properties, especially chemical, may be reliably evaluated. Now-routine soil analyses assist growers in knowing how much lime and fertilizer (synthetic or organic) may be needed. But, physical and biological properties are more difficult or expensive to measure accurately and interpret. Therefore, qualitative assessments may be most practical and several tools are available to accomplish this. They include the Ohio Soil Health Card and the USDA Soil Quality Test Kit. The Ohio Soil Health Card evaluates soil quality based on indicators identified by farmers. The Card was developed for farmers by farmers and is a tool to help monitor and improve soil quality based on farmers' experience and knowledge of their soils. Regular use of the Card allows farmers to record long-term trends and changes in soil quality and to compare the effects of different soil management practices. The Card provides a qualitative assessment of soil quality in a field and is most effective when filled out consistently over time by the same person.

The USDA Soil Quality Test Kit is a toolbox with components for making relatively simple and inexpensive estimates of soil quality in the field. The test kit was developed by the Agricultural Research Service, refined and expanded by the NRCS Soil Quality Institute, and designed for ease of use by farmers, consultants, Extension and NRCS staff, and other agricultural professionals. The Kit's guide carries instructions on how to complete the tests, worksheets for recording data and calculating results, and suggestions on how to interpret the results.

Vegetable crops tend to return small amounts of organic material to the soil after harvest. Also, vegetable production often involves frequent field traffic and intensive tillage and cultivation. Together, these factors make it difficult to maintain soil quality in vegetable production. However, taking several key steps can help maintain or improve soil quality. First, recognize that soil quality must be managed with the same energy and focus as other production issues, like pests and diseases. Planting, growing, protecting, and harvesting the crop are large chores requiring a lot of attention. Maintaining or improving soil quality will benefit all other aspects of production. Second, recall that organic matter plays a key role in nearly all soil properties. Organic matter levels have declined 30%-50% in many areas, signaling potentially troublesome declines in soil quality. Extensive tillage and cultivation (especially of wet soils), short and repetitive rotations, not using cover crops, and returning little residue to the soil tend to reduce soil organic matter and, by association, soil quality. Of the many factors which effect soil quality, soil organic matter may be the most critical. Therefore, taking steps to maintain or increase soil organic matter levels is very important. These steps include: 1) reducing tillage, 2) diversifying and lengthening rotations (include legumes and deep-rooted and high-residue crops), 3) adopting a "no bare soil" philosophy whereby erosion of organic matter-rich topsoil is minimized and return of organic matter to the soil is increased, and 4) applying organic soil amendments, being careful to avoid nutrient imbalances or deficiencies when doing so. Finally, avoid the urge to work soil when it is wet. Working wet soil compacts it. Compacted soils produce weak, input-demanding, low-yielding crops. They are also difficult to repair.

Soil quality is "the capacity of a soil to function." Farmers prefer that their soil supports ideal crop growth

with minimal inputs, season after season. Therefore, growers should be familiar with the physical, chemical, and biological aspects of soil quality and soil management practices that maintain or improve them. Along with preventing erosion, sustaining or increasing soil organic matter levels may be the most important step growers can take in managing soil quality. Practices such as lengthening and diversifying rotations, minimizing tillage and cultivation, and growing cover crops are useful in accomplishing these goals. Exercising restraint and not working soil when it is wet (a common urge in springtime planting preparation) helps maintain soil structure, an important aspect of soil quality.

For More Information

Publications

A bulletin on soil quality management in vegetable and small fruit production will be available from OSU Extension and the OSU Piketon Research and Extension Center in Spring 2001.

Building Soils for Better Crops, 2nd ed. 2000. F. Magdoff and H. van Es. Sustainable Agriculture Network. Handbook Series Book 4. 240 pp.

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Methods for Assessing Soil Quality. 1996. J. Doran and A. Jones, (eds). SSSA Special Publication Number 49. Soil Science Society of America.

Nutrient Cycling & Maintaining Soil Fertility. 2000. P. Bierman. OSU Centers at Piketon. SWR-3. 15 pp.

Ohio Soil Health Card. 1999. P. Bierman, N. Widman, and R. Gehring (eds). OSU Centers at Piketon. SWR-1. 4 pp.

Soil Biology Primer. 1999. Bulletin PA-1637. Soil Quality Institute, USDA-Natural Resources Conservation Service. 50 pp.

Soil Management. 1997. Best Management Practices Series. Ontario Ministry of Agriculture, Food, and Rural Affairs; Agriculture and Agri-Food Canada; Ontario Federation of Agriculture. 68 pp.

Soil Quality Information Sheets. National Soil Survey Center in cooperation with the Soil Quality Institute, USDA-Natural Resources Conservation Service and the National Soil Tilth Laboratory, USDA-Agricultural Research Service.

The Soil Management Series. 2000. PC-7398-S (complete series). Minnesota Institute for Sustainable Agriculture; Soil Quality Institute, USDA-Natural Resources Conservation Service; University of Minnesota Extension Service.

Websites

The slide set used in this presentation is located at: http://www.oardc.ohio-state.edu/kleinhenz/

Soil & Water Resources Program, OSU Piketon Res. & Ext. Center: http://www.ag.ohio-state.edu/~prec/soil/

NRCS Soil Quality Institute: http://www.statlab.iastate.edu/survey/SQI/

Soil Health Slide Show, Northeast Region Sustainable Agriculture Research & Education Program: http://www.uvm.edu/~nesare/slide.html