Soil Quality Indicators

decomposition, and other processes contributing to soil respiration. Chemical fertilizer may stimulate root growth and nourish microbes; however, at high concentrations, some fertilizers can become harmful to microbes responsible for soil respiration because of changes in pH and their potential toxicity. Similarly, organic amendments with high concentrations of heavy metals, as well as pesticides and fungicides, may be toxic to microbial populations leading to reduced microbial diversity, abundance, and respiration.

Relationship to Soil Function

Soil respiration reflects the capacity of soil to support soil life including crops, soil animals, and microorganisms. It describes the level of microbial activity, SOM content and its decomposition. In the laboratory, soil respiration can be used to estimate soil microbial biomass and make some inference about nutrient cycling in the soil. Soil respiration also provides an indication of the soil's ability to sustain plant growth. Excessive respiration and SOM decomposition usually occurs after tillage due to destruction of soil aggregates that previously protected SOM and increased soil aeration. Depleted SOM, reduced soil aggregation, and limited nutrient availability for plants and microorganisms can result in reduced crop production in the absence of additional inputs. The threshold between accumulation and loss of organic matter is difficult to predict without knowledge of the amount of carbon added.

Problems with Poor Function

Reduced soil respiration rates indicate that there is little or no SOM or aerobic microbial activity in the soil. It may also signify that soil properties that contribute to soil respiration (soil temperature, moisture, aeration, available N) are limiting biological activity and SOM decomposition. With reduced soil respiration, nutrients are not released from SOM to feed plants and soil organisms. This affects plant root respiration, which can result in the death of the plants. Incomplete mineralization of SOM often occurs in saturated or flooded soils, resulting in the formation of compounds that are harmful to plant roots, (e.g. methane and alcohol). In such anaerobic environments, denitrification and sulfur volatilization usually occur, contributing to greenhouse gas emissions and acid deposition.

Improving Soil Respiration

The rate of soil respiration under favorable temperature and moisture conditions is generally limited by the supply of SOM. Agricultural practices that increase SOM usually enhance soil respiration. The following practices have the potential to significantly improve SOM and indirectly soil respiration when other factors are at an optimum:

- Conservation tillage (no-till, strip-till, mulch till, etc.)
- Application of manure and other organic by-products
- Rotations with high residue and deep-rooted crops
- Cover and green manure crops
- Irrigation or drainage
- Controlled traffic

Measuring Soil Respiration

Soil respiration is measured using the Draeger-Tube® method described in the Soil Quality Test Kit Guide, Chapter 2, p 4 - 6. See Section II, Chapter 1, p 52 - 54 for interpretation of results.

References:
Parkin TB, Doran JW, and Franco-Vizcaíno E. 1996. Field and Laboratory Tests of Soil Respiration. In: Doran JW, Jones AJ, editors. Methods forJgbBll3Ir