Lancrop Laboratories

Technical Note:
Soil Respiration Test

# Soil Respiration Test

### Why measure?

There are more organisms in a handful of healthy soil than there are people on the earth. If the soil is to be healthy, fertile and productive, then this population should be of adequate size, diversity and activity.

Some of the bacteria and fungi are help sustain plant growth as they break down organic matter and release plant available forms of key plant nutrients, particularly nitrogen, sulphur and phosphorus. Soil organisms also improve the structure of the soil by increasing soil porosity, improving drainage and providing aeration channels, allowing plant roots greater access to water and nutrition.

Measuring your soil's biological activity provides valuable insight into whether your soil management practices are sustaining or improving overall soil health. Establishing a biological baseline for your soil allows you to assess and optimise management practices.

Typical Soil Organism Numbers
Temperate, freely drained soil under arable cropping

| Organism | Number per gram of soil |
|---|---|
| Bacteria | 100,000,000 |
| Actinomyces | 2,000,000 |
| Fungi | 200,000 |
| Algae | 25,000 |
| Protozoa | 10,000 |
| Nematodes | 1.5 |
| Earthworm | 1 per kg |

REF: T. BATEY - 1988

### Soil respiration laboratory test

Soil respiration is a measure of the $CO_2$ released from the soil and this measurement can be used to estimate microbial activity, the nutrient cycling capability of the soil and it's potential to sustain plant growth.

The Solvita $CO_2$ respiration test has been developed as a standardised laboratory test that provides an indication of soil biological activity. Measuring the biological activity of a soil provides an insight into whether soil management practices such as crop rotations, cover-cropping and reduced tillage are sustaining or improving overall soil health.

### Interpretation

| Respiration Activity * | Very low | Low | Slightly low | Normal | High |
|---|---|---|---|---|---|
| Approximate N-min potential per year** | < 10 kg/ha | 10 - 20 kg/ha | 20 - 40 kg/ha | 40 - 80 kg/ha | 80 - 160 kg/ha |

* Under optimum soil temperature and moisture conditions
** Under 'normal' climatic conditions

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Soil biological activity increases with increasing soil organic matter content and increasing soil porosity. Management practices can increase or decrease the content of SOM and the potential for compaction.

| Management practice | Application | Short-term impacts | Long-term impacts |
|---|---|---|---|
| Application of solid manure or organic matter | Apply at proper agronomic rate. Provides carbon and nitrogen to microbes, increasing their activity. | Increased respiration when manure begins to break down; increased biomass/forage production. | Improved soil structure; increased fertility and SOM content. |
| Use of high residue crops or cover crops in rotation | Crops that have a high ratio of carbon to nitrogen (C:N) produce a high amount of biomass. Leave residue on soil surface to increase SOM. | Temporary fixation of nitrogen during residue breakdown; increased soil moisture; decreased erosion. | Improved soil quality; increased fertility and SOM content. |
| Tillage, such as annual discing or ploughing | Mixes the soil, resulting in a temporary increase in oxygen and contact of residue to soil, allowing microbes to break down carbon sources. | Released N, other nutrients and CO2; increased potential for erosion; increased rate of decomposition of residue and other carbon sources. | Decreased SOM content, soil quality and fertility; reduced diversity of micro-organisms (increased bacteria); damaged soil structure. |
| Use of crop residue | Leave residue on the surface, increasing ground cover, to protect the soil. | Nitrogen temporarily tied up during breakdown of residue; increased soil moisture; decreased risk of erosion; lowered soil temperature. | Increased soil quality, fertility, and SOM. |
| Application of nitrogen fertilizer or manure | Provides nitrogen (energy), which allows microbes to break down residue with high C:N ratio more rapidly (e.g., corn stalks, wheat straw). | Temporary increased respiration due to increased rate of organic material breakdown. | If properly managed, increased SOM and soil quality; increased production and residue. |
| Use of farm equipment or other vehicles | Compacts soil, decreasing pore space, water movement, and oxygen and increasing nitrogen loss from denitrification. | Decreased respiration, yields, and water infiltration; increased runoff. | Decreased production; increased risk of erosion and runoff; decreased soil quality and microbial activity. |

USDA Soil Health: Guides for Educators https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051573.pdf

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