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Soil air

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Introduction

Soil requirement is met from the soil air, or more precisely, the gas phase of soil. In a soil, the volume of gas phase varies indirectly with of the liquid phase or the water content of the soil. Thus as a saturated soil becomes unsaturated, the pores which are drained of water are immediately filled with air. On restoration, water replaces air. As the moisture content of the soil increase, the air content decreases and vice-versa. The pores that are not filled with organisms living in the soil uses oxygen from it. Oxygen is essential for all biological reactions occurring in soil. Excess of carbon dioxide is toxic to many plant. Plants carry on respiration, utilize energy and release carbon dioxide which can be shown in a generalized equation

$$C_6H_{12}O_6+6O_2\text{---------}6CO_2+6H_2O+Energy$$

Definition of soil aeration: The constant movement of air in the soil mass resulting in the renewal of gases is known as soil aeration Thus a well-aerated soil is one in which gases are available to growing aerobic organism (including higher plant) is sufficient quantities and in the proper proportion to encourage optimum rates of the essential metabolic processes of the organisms.

Composition of soil air: The composition of soil air is more or less similar to that of the atmospheric air except that the content of carbon dioxide (co_2) is several times higher. Soil flora and fauna consume oxygen and give out carbon dioxide. The carbon dioxide in soil is partially dissolved in soil solution and partially remains in the gaseous phase. Composition of soil air varies depth wise. Present data on composition of soil air of a fallow land at pusa Bihar. The concentration of co_2, it may be noted, increases after the rains, probably because of increased nitrification and decomposition of organic matter.

The amount of carbon dioxide in soil air is 5 to 10 times higher than that in atmospheric air. The difference between the soil's rate of carbon dioxide production and removal determines the oxygen content of the air in the soil. It's possible for soil-produced carbon dioxide to seep into the atmosphere.

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Composition of soil gas in fallow land before and affter rain				
Before rain				
Depth (cm)	**Nitrogen %**	**Oxygen %**	**CO_2**	**Argon %**
0-7.6	78.45	20.44	0.12	0.988
7.6-15.2	78.44	20.30	0.25	1.007
15.2-22.8	77.08	20.29	1.65	0.976
22.8-30.5	78.21	20.56	0.29	0.937
After rainfall(10.7cm)				
Depth (cm)	**Nitrogen %**	**Oxygen %**	**CO_2**	**Argon %**
0-7.6	78.43	19.64	0.97	0.954
7.6-15.2	78.85	19.67	0.57	0.923
15.2-22.8	79.10	18.99	0.94	0.967
22.8-30.5	78.95	18.75	1.32	0.978

	Nitrogen	oxygen	CO_2
Atmospheric Air	79	20.95	0.03
Soil air	79-80	18-20	0.15-0.3

Factors Affecting the Composition of Soil Air

The composition of soil air is influenced by a number of factors such as nature of soil, soil condition, type of crop, microbial activity, season etc.

Oxygen: The quantity of oxygen in soil air is less than that in atmospheric air. The amount of oxygen also depends upon the soil depth. The oxygen content of the air in lower layer is usually less than that of the surface soil.

Carbon dioxide: Decomposition of organic matter produces carbon dioxide hence, soil rich in organic matter contain higher percentage of carbon dioxide.

Temperature and Season: temperature and season also influence the CO_2 content in the soil air. High temperature during summer season encourages microorganism activity which resulting in higher production of carbon dioxide.

Light texture: Light texture soil ig. Sandy soil contains much higher oxygen percentage heavy soil. Soils on which crops are grown contain more co_2 than fallow lands. The amount of co_2 is usually much greater near the roots of plants than further away. It may be due to respiration by roots.

Soil air in relation to plant growth

Concentration of Co_2 in soil air in excess of 1% causes toxicity to most crop

plant. Thus relative concentration of co_2 and oxygen in soil air is of significance from the point of view of most crops. This is summarized below.

Availability of water and nutrients: When oxygen is less in soil, plant roots are unable of extract more water and nutrients. Even under water logging condition, plant may suffer shortage of water and nutrients, which they could not absorb due to lack of oxygen.

Oxygen diffusion rate: Oxygen diffusion rate (the rate at which oxygen in the soil exchanges with oxygen in the atmosphere) indicates the rate at which oxygen can be replenished when it is used by plant roots or by soil micro-organisms. Water can also force out oxygen. The rate of growth of roots of most plant ceases when the oxygen diffusion rate is below 20×10^{-8} g/cm^2/minute.

Soil aggregation: The failure of poorly aggregated soil to respond to fertilization may by because of deficient oxygen supply and low nutrient absorption.

Microbilal activity: All aerobic organisms need oxygen to function property. Under poor aeration condition only anaerobic and facultative micro-organisms can function.

Root growth and development: Aeration requirements for plants differ. Legumes are sensitive to poor aeration whereas grasses are tolerant. Oxygen dificiency disturbs metabolic processes in plants, resulting in the accumulation of toxic substances in plants.

Incidence of diseases: Insufficient soil aeration is associated with the incidence of diseases in some crops. Wilt, a very common fungal disease of plants, is due to water logging of surface soil.

Accumulation of toxic substances: Poor aeration results in the development of toxins and other injurious substance such as dihydroxystearic acid. It leads to the accumulation of organic acids such as butyric, lactic, acetic etc. in toxic quantities.

Maintenace of soil aeration

Relation to soil and crop management, following In order to maintain proper aeration in practices should be adopted.

Maintenance of soil moisture: Removal of excess quantities of water is necessary if sufficient oxygen is to be supplied. Control of soil moisture is necessary for better soil aeration.

Maintenance of stable aggregates: Maintenance of stable soil structure is important for augmenting good aeration (macro pores). This is done by maintenance of organic matter by addition of farmyard manure and crop residues.

Cultivation practices: Cultivation of heavy texture soil is an aid to soil aeration. Frequent light cultivation is good for crops

with large taproots as this encourages soil aeration.

Selection of crops and their varieties: Selection of crops tolerant to low levels of oxygen. Shallow rooted plants such as grasses do well on poorly aerated soils. Rice plant flourishes even when the soil is submerged with water. Contrary to this, fruit and forest trees require deep, well-aerated soils.

Other management practices:

- Improving soil structure. Granular and crumb structure increases macro pores.
- Addition of organic matter increase stability of aggregates.
- Adopting proper cultivation practices, light intercultural operations.
- Improving soil drainage will enhance gaseous exchange.