MICROBIOLOGY OF THE RHIZOSPHERE AND ITS EFFECTS

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Microbiology of Rhizosphere:

The soil surrounding the plant root where root exudate migrate and microbiological activity is exceptionally high is called rhizosphere. The surface of root is called rhizoplane.

Plant root produce and release various exudates containing sugar, aminoacids, organic acids, fatty acids, vitamins, nucleotides and other organic matters that promotes growth of microorganisms.

Therefore rhizospheric soil is characterized by greater number of microorganisms than soil away from plant roots.

The intensity of rhizospheric effects depends on the distance to which root exudates can diffuse. The number of microorganisms decreases continuously as the distance from the plant root increases.

The term rhizosphere to soil ratio (R:S) indicates number of microbes in rhizospheric soil divided by number of microbes in soil free of plant root.

R:S ratio is greater for bacteria (20:1) and less for fungi and actinomycetes.

Effects of rhizosphere is almost negligible for algae and protozoa. It is because algae are photosynthetic and do not depends upon organic matter present in root exudates.

On the other hand most bacteria cannot utilize relatively resistant to organic matter of soil and depends on easily available decomposable matter of root exudates. Therefore number of bacteria is exceptionally high in rhizosphere.

Examples of rhizospheric microorganisms:

Large number of bacteria, fungi and actinomycetes are found in rhizosphere.

i. Bacteria:

Many nitrogen fixing bacteria and phosphate solubilizing and other bacteria are found in rhizosphere.

For example: *Pseudomonas, Arthrobacter, Azotobacter, Agrobacterium, Flavobacterium, Cellulomonas, Rhizobium, Clostridium* etc.

ii. Fungi:

Some fungi are found associated with root forming mycorrhiza and other occurs freely in soil.

For example: *Marticella, Cephalosporium, Tricoderma, penicillium, Gliodadium, Gliomastix, Fusorium* etc.

iii. Actinomycetes:

Frankia, Derxia etc

Factor affecting rhizospheric microorganisms:

Various factors affect rhizospheric microbes and some of them are;

i. Proximity of soil to root:

The number of rhizospheric organisms is greater near the root and their number continuously decreaseswith increase in distance from the root.

It is because concentration of organic matter released by root in exudates decreases with increases in distance from the root.

ii. Temperature and light intensity:

Low temperature and low light intensity decreases the rate of exudate secretion from the root so that number of rhizospheric organisms decreases.

On the other hand number of microbes in rhizosphere increases when temperature and light intensity increases as multiplication rate is high.

iii. Type of soil:

Types of soil also influences rhizospheric effects.

For example; R: S ratio is very high in sandy soil and low in clay soil. It is because sandy soil contains very little or no organic matter and the root region is the only place where organics matter is available and microorganisms can grow. Therefore, number of microbes is high around root in sandy soil.

On the other hand in fertile soil such as clay soil, organic matter is sufficiently available for growth, so microorganisms need not to depend on the root exudates for growth.

iv. Age of plant:

With age of plant, rate of exudates secretion is altered so that number of rhizospheric microbes changes.

v. Types of plant and location of root:

Location of root affects number of rhizospheric microbes.

Root cap and regions of root from where lateral root arises are primary sites of exudate secretion. Therefore, number of microbes is comparatively high around these locations.

Amount and type of exudates secretion differs with species of plant that influences growth of rhizospheric microbes. For example; some plant root release antimicrobial chemicals such as glycosides, hydrocyanic acids and several antifungal agents that inhibits rhizospheric microbes.

vi. Depth of root:

In general number of rhizospheric microorganisms decrease with increase in depth of root, which is mainly due to anaerobic condition.

vii. Root respiration:

Plant root release carbon-dioxide during respiration that make the soil acidic.

Acidity of soil decrease number of rhizospheric bacteria.

viii. pH of soil:

pH of rhizosphere become acidic due to root respiration and by oxidation of sulphur caused by Thiobacillsu spp. Acidification of rhizospheric soil decrease number of microorganisms.

ix. Pesticides and antibiotics:

Spray of pesticides and antibiotics on agriculture crops decreases the number of rhizospheric organisms.

Role of rhizospheric microbes:

Rhizospheric microorganisms are important for plant growth. They promote plant growth by various ways as given below;

Some rhizospheric bacteria such as *Rhizobium, Azotobacter, Clostridium* etc. fix atmospheric nitrogen and make it available for plant gowth.

Many phosphate solubilizing microbes such as *Bacillus polymyxa* found in rhizosphere release free phosphate from inorganic salt of phosphate. Free phosphate is important nutrient for plant growth.

Several rhizospheric microbes (*Azotobacter, Arthrobacter, Pseudomonas, Agrobacterium*) produce growth hormone such as Gibberllin, Indole acetic acid (IAA) etc that promote plant growth.

Many rhizospheric fungi are associated with plant root in the form of mycorrhiza. Mycorrhizal fungi promote plant growth by various ways.

Rhizospheric microbes induce development of lateral root, root hairs development and mucilage secretion from plant root.

Some rhizospheric microbes produces antibiotics and other antimicrobial chemicals that inhibit plant pathogens. Some time it may inhibit beneficial N2 fixing and phosphate solubilizing bacteria.

Microorganisms also increase rate of exudate secretion. Exudate secretion from plant root helps in formation of soil aggregate that improve soil fertility.

Some rhizospheric microbes e.g. *Pseudomonas* produces Siderophore. Siderophore is a chelating agent that tightly bind iron and make it unavailable for growth of pathogenic microorganisms.

Effect of plant root on rhizospheric microbes:

Plant root usually promote growth of rhizospheric microbes. Sometimes plant root give minor unwanted effect to microorganism. Some of them are;

- Plant root produce exudate containing carbohydrate, aminoacids, nucleotide, vitamins etc that serves as food for growth of rhizospheric microbes.
- Some plant root produces antimicrobial chemicals such as glycosides, Zhydrocyanic acids and antifungal agents that inhibits growth of rhizospheric microorganisms.
- Plant root release CO2 during respiration that make habitat acidic and anaerobic.
- Some plant root produce chemicals that bring fungistasis. Fungistasis is referred to the inability of spore to germinate. For e.g. root of *Allium* produce alkylcystein sulfoxide that inhibit germination of sclerotia (spore) of *Sclerotium capivarum*.

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