Distribution and role of microorganisam

1. Soil is a dynamic habitat for an enormous variety of life-forms.
Soils give a mechanical support to plants from which they extract nutrients. soil provides shelters for many animal types, from invertebrates such as worms and insects up to mammals like rabbits, moles, foxes and badgers. It also provides habitats colonised by a staggering variety of microorganisms.

2

All these forms of life interact with one another and also interact with the soil to create continually changing conditions. This allows an on-going evolution of soil habitats.

2. Distribution of Microorganisms

Microorganisms constitute < 0.5% (w/w) of the soil mass yet they have a major impact on soil properties and processes. 60-80 % of the total soil metabolism is due to the microflora.

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These are the smallest organisms (<0.1 mm in diameter) and are extremely abundant and diverse. They include algae, bacteria, cyanobacteria, fungi, yeasts, myxomycetes and actinomycetes that are able to decompose almost any existing natural material. Micro-organisms transform organic matter into plant nutrients that are assimilated by plants. Soil organisms represent a large fraction of global terrestrial biodiversity.

4

3. Soil organisms can be grouped on the basis of:
–Size: how big they are
–Species: who they are related to
–Function: how they make their living

One gram of topsoil may contain:
. as many as one billion bacteria
. up to 100 million actinomycetes
. one million fungi
. 100 nematodes

5

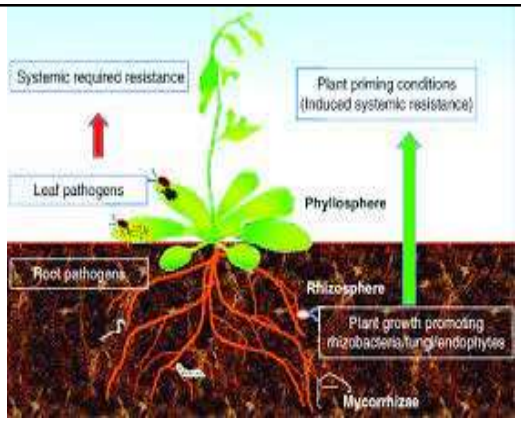
. Importance of Soil Organisms

Responsible for cycling of C, N and other utrients
Enhance soil structure
Relocate and decompose organic materials
Maintain soil quality and health
Increase soil aeration and penetrability
Involved in disease transmission and control.

6

5. Rhizosphere

The rhizosphere is the region of soil immediately adjacent to and affected by plant roots. It is a very dynamic environment where plants, soil, micro-organisms, nutrients and water meet and interact. The rhizosphere differs from the bulk soil because of the activities of plant roots and their effect on soil organisms.



Types of Microbes

- Named based on their particular physiological and nutritional characteristics.

Oxygen	Description
Aerobe	Capable of using oxygen as a terminal electron acceptor
Anaerobe	Grows in the absence of oxygen
Facultative anaerobe	Can grow aerobically or anaerobically
Microaerophile	Capable of oxygen-dependent growth but only at low oxygen levels

Temperature	Description
Psychrophile/ facultative psychrophile	Optimal temperature for growth is 15 °C or lower, maximal temperature is approximately 20 °C, and minimal temperature is 0 °C or lower
Psychrotroph	Capable of growing at 5 °C or below, with maximal temperature generally above 25 °C to 30 °C
Mesophile	optimal temperature for growth, which is approximately 37 °C; frequently grows in the range from 8 °C to 10 °C and from 45 °C to 50 °C
Thermophile	Grows at 50 °C or above
Hyperthermophile	Grows at 90 °C or above, although optimal temperature for growth is generally above 80 °C; maximal growth of pure cultures occurs between 110 °C and 113 °C,

pH	Description
Acidophile	Grows at pH values less than 2
Alkalophile	Grows at pH values greater than 10
Neutrophile	Grows best at pH values near 7

Salinity	Description
Halophile	Requires salt for growth: extreme halophiles (all are archaea), 2.5 M to 5 M salt; moderate halophiles, usually low levels of NaCl as well as 15 to 20 percent NaCl

Hydrostatic pressure (100 atmospheres per 1,000-m depth)	Description
Barophile	Obligate barophiles, no growth at 1 atmosphere of pressure; barotolerant bacteria, growth at 1 atmosphere but also at higher pressures. (0.987 atm = 1 bar = 0.1 megapascal [Mpa])

Microbes in Agriculture

Microbes are harmful but some microbes are useful for our day to life.

- Microbes in agriculture used as-
  - Bio-control agent.
  - Biological fertilizer/ Biofertilizer.

Role of Microorganisms in Agriculture

- Microorganisms play an important role in agriculture.
- The microorganisms include- bacteria, fungi, algae, protozoa, viruses.
- Microorganisms help in organic matter decomposition, humus formation.
- The important role of microorganisms includes – Nitrogen fixation, phosphate solubilisation, potassium mobilisation, antagonism towards pathogens, pests.
- Hence , the role of microorganisms in agriculture is indispensable.

Biofertilizers

- The natural fertilizers of which the main constituents are living microbial
- inoculants including algae, fungi, bacteria alone, or in combination
- and have ability to enhance the availability of nutrients in soil for
- plants .
- They have an ability to convert the nutritionally important component present in the soil from unusable form to the usable form by their microbial activities including phosphate solubilization, nitrogen fixation, excretion of plant growth hormones, and biodegradation in the soil.
- The use of biofertilizers is eco-friendly, productive, easily accessible to marginal farmers, and more efficient .
- A lot of studies have been made to exploit the use of microorganisms and their associations for the production of biofertilizer.
- They can be grouped as following on the basis of their function and nature.

Rhizobium

- Rhizobia are the soil habitat bacteria that have ability to clone in lines of
- roots of legume plants and can fix much of free nitrogen. In regard to the
- quantity of nitrogen they fix, they are the most efficient biofertilizers [8].
- **Arbuscular mycorrhizal fungi**
- The intracellular obligate microbes are present in association with the
- root cortex of higher plants and absorb the essential elements including
- phosphorus, zinc, and sulfur from the soil. They can work as biofertilizer
- and are mostly from the genius glomus [9].

Azotobacter

- Other than rhizobium bacteria, the azotobacter also has an ability to fix
- nitrogen. The several species of azotobacter are present in the soil and
- can act as biofertilizer .

- **Cyanobacteria**
- Cyanobacteria is a blue green algae and found as free living or as
- symbiotic association with rice crop and can produce the fixed nitrogen

Biopesticides

- The soil also has the plant pathogenic bacteria that are present in the rhizospheric zone and it can cause a lot of diseases in the plant.
- By making the use of these pathogenic microbes, scientist has made
- the biological tool to control the unwanted weeds and pests. These
- microbes possess the genes that are invasive and can attack on the
- weeds and kill them .

Bioinsecticides

- Bioinsecticides has been developed to minimize the use of synthetic,insecticides by making the use of microorganisms.
- Because of shortest,shelf life, they do not persist in environment and are also eco-friendly.
- For example, 200 diseases are caused by fungi in insects that can control,their population

Biological control agents

- First coined by Harry Smith in relation to the biological control of insects.
- Biological control agents are
  - Pollution free.
  - Host specific.
  - Expensive.

EFFECTIVE MICROORGANISM

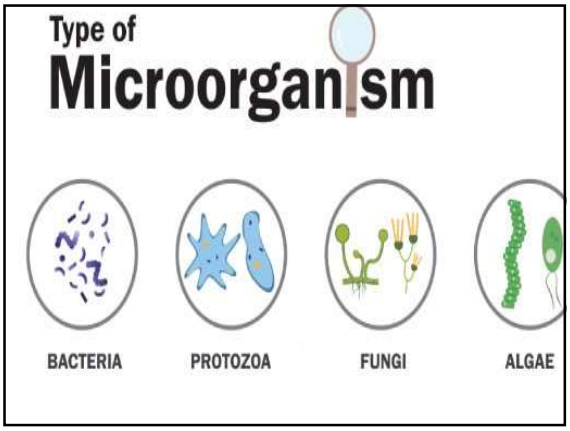
- Complex microorganism solution.
- It contains mainly 3 species such as Lactic acid bacteria, Yeast, Phototrophic Bacteria.
- Collected from food industries and nature

EM IN AGRICULTURE

- Enhances the photosynthetic capacity of crops
- Develops resistance of plants to pests and disease
- Improves physical, chemical and biological environments of the soil and destroy soil born pathogens and pests

Microbes in Agriculture

- Bio-control agent are expensive ,safe then chemical pesticides.
- Biofertilizers are cheap ,safe and renewable resources rather than chemical fertilizers.
- At last microorganisms play an important role in Agriculture.



role of microorganisms in human health

- It has been considered that there are about 100 trillion cells in a human body. However, even one tenth are hardly real human cells.
- human body is home of trillions of bacteria, viruses, fungi, and other tiny organisms. Hence organisms are known as microbes. Humans and microbes rely on these interactions to
- Di erent species of microbes live at di erent places in and on human body and these are adapted to the conditions

Microbes on Skin

- Skin is the largest human organ which is the point of contact with the world.
- He most diverse populations of microbes present in human live on the skin.
- Here are at least 1,000 di erent species of bacteria,fungi, viruses and other microbes which live on the skin.
- Most of which are harmless or even beneficial to human host. Colonization on skin is highly variable depending on endogenous host factors, topographical location and exogenous environmental factors.
- Symbiotic microorganisms occupy a wide range of skin niches and protect against invasion by more pathogenic or harmful organisms.
- One example of bacteria that protects the skin is Bacillus subtilis.
- It produces bacitracin on the skin, a toxin that helps it in fighting with other microbes

Microbes in Nasal Cavity

- A little is known about the microbes in nasal cavity. However,
- evidences suggested that microbiota of the nasal cavity plays a crucial role in determining the reaction patterns of the mucosal and systemic immune system.
- Di erent microbiota are found in di erent parts of the nasal cavity.
- Many studies are conducted to know about the
- microbiota of nasal cavity.
- He studies suggested absence of Gramnegative bacteria in nasal passage that are regularly present in pharyn

Microbes in Mouth/Oral Cavity

- He oral cavity or mouth includes several distinct microbial habitats

such as teeth, gingival sulcus, gingiva, tongue, cheek, lip, gingival sulcus hard palate, and soi palate.

- He microorganisms found in the human oral cavity are called as the oral microflora, oral microbiota or oral microbiome. His microflora comprises over 600 species with distinct combination at di erent habitats.
- Most organisms that are colonizing are beneficial to human health but some microbes transit from a commensal relationship to pathogenicity.
- He reasons for the transition are not understood, however it is believed that it may be because of changes in the environment or personal hygiene

Microbes in Human Gut

human gut serves two major functions: nutrition and defense.

It digests food, absorbs nutrients, and assists with waste excretion.

At the

- same time, intestine serves as house for enormous population of microbes that help in digestion and guard against pathogenic microbes.
- intestinal microbiota of newborns is characterized by low diversity and a relative dominance of the phyla Proteobacteria and Actinobacteria.
- Initial microbial colonization of the gut in infants appears to be dependent on delivery mode that is vaginally delivered babies acquire microbiota similar to those of their mother's vagina(dominated by Lactobacillus and Prevotella) and babies delivered via caesarian section acquire microbiota similar to those typically associated with the skin which has Staphylococcus, Propionibacterium

Microbes in Reproductive Tract

- Successful human reproduction is possible by the existence of healthy microbial community in the reproductive tract.
- Microbial communities exist throughout the entire length of the female reproductive tract at variable composition and density and play a role in reproductive cyclicity, gametogenesis, pregnancy and successful delivery of newborns.
- vaginal microbiota play a key role in the prevention of multiple diseases including bacterial vaginosis (BV), yeast infections, sexually transmitted diseases, urinary tract infections, and human immunodeficiency virus

There are many useful application of microbes in the food industry.

- They influence the quality, availability and quantity of food.
- Microorganisms are used to change one substance to another which is used as food, such as milk to yoghurt and cheese, sugar to wine and bread.

What are the three functions of microorganisms in relation to food?

- Micro-organisms, in relation to food, can have one of these 3 roles:
- Pathogenic micro-organisms can cause infections or intoxications.
- Saprophytic micro-organism play a role in biodegradation and cause food spoilage. Cultured micro-organisms like probiotic bacteria are used in food processing

Microorganism Growth and Food Spoilage

- Different food products provide different growth conditions for microorganisms. Microbial growth is controlled by intrinsic factors like nutrients, pH, moisture content, the physical structure of the food and/or extrinsic factors like temperature, relative humidity, gases (CO_2, O_2).
- Microorganisms thus grow in optimum conditions provided by the external and internal factors and result in spoilage and degradation of the food product resulting in a sour, foul-smelling or fungus-covered inedible mass.

- Microbial growth in foods can also cause visible changes like change in colour, deposition of powdery growth, effervescences on the food surface, etc.
- Microbial contamination of food can occur at any point in the food production process: growth, harvesting, transport, storage, or final preparation.
- Spoilage also can occur if foods are not stored properly. Meat and dairy products are rich in protein and fat serves as an ideal environment for microbial spoilage resulting in proteolysis and putrefaction of the food products.
- Vegetables and fruits have a much lower protein and fat content and undergo a different kind of spoilage.

Uses of Microorganisms in the Food Industry

- Currently, more than 3500 traditionally fermented foods exist in the world.
- They are of animal or vegetable origin and are part of our daily life. Alcoholic drinks are not the only fermented drinks; cocoa beans, coffee grains and tea leaves are fermented after harvest in order to develop their typical flavour profiles.
- Bacteria are the largest group of unicellular microorganisms.
- The shapes of medically important bacteria are classified into-cocci, or spherical cells; bacilli, or cylindrical or rod shaped cells; and spiral or curved forms.
- The pathogenic or disease causing bacteria are usually gram negative, however, three gram-positive rods are known to cause food intoxications : Clostridium botulinum,C. perfringens,and Bacillus cereus

- Some of the other most common bacteria causing food spoilage, infections and disease are Acinetobacter, Aeromonas, Escherichia, Proteus, Alcaligenes, Flavobacterium, Pseudomonas, Arcobacter, Salmonella, Lactococcus, Serratia, Campylobacter, Shigella, Citrobacter, Listeria, Staphylococcus, Micrococcus, Corynebacterium, Vibrio Enterobacter, Paenibacillus, Weissella, Enterococcus, Yersinia
- Different strains of bacteria are also used in production of various food and dairy products. Strains of Streptococcus, Lactobacillus Bifidobacterium, Erwiniaetc. are used in the production of fermented food and dairy products. Streptococcus thermophilus and Lactobacillusbulgaricus are used to produce yogurt.

Agriculture Food and Analytical Bacteriology

- Analytical microbiology is a study, application and use of microorganisms as reagents for the quantitative determination of certain chemical compounds.
- These procedures are based on the reaction of a particular microorganism to its environment.
- If a microorganism reacts with a measurable response to a certain chemical entity and yields a suitable result, then this analytical method for the quantitative estimation of the substance may be devised as per the requirements of food culture, fermentation or preservation.

Molds:

- Molds are multicellular filamentous fungi whose growth on foods is usually readily recognized by their fuzzy or cottony appearance.
- They are mainly responsible for food spoilage at room temperature 25- 30oC and low pH, and have minimum moisture requirement.
- Molds can rapidly grow on grains and corns when these products are stored under moist conditions.
- Molds require free oxygen for growth and hence grow on the surface of contaminated food.
- Molds also find their use in manufacturing of different foods and food products.
- They are used in ripening of various types of food products as cheese (e.g. Roquefort,Camembert).

Yeasts:

- Yeasts have the ability to ferment sugars to ethanol and carbon-dioxide and hence they are extensively in food industry.
- The most commonly used yeast, the baker's yeast is grown industrially.
- Saccharomyces carlsbergensis is most commonly used in fermentation of most beers.
- The other yeast strains of importance are Brettanomyces, Schizosaccharomyce,, Candida, Cryptococcus, Debaryomyces, Zygosaccharomyces, Hanseniaspora, Saccharomyces

role of microorganisms in industry

- Microbes, or microscopic organisms, are widely used in large-scale industrial processes.
- They are crucial for the production of a variety of metabolites, such as ethanol, butanol, lactic acid and riboflavin, as well as the transformation of chemicals that help to reduce environmental pollution

In large-scale industrial processes, microbes are widely used to synthesize a number of products valuable to human beings

There are numerous industrial products that are derived from microbes such as:

- Food additives.
- Alcoholic and non-alcoholic beverages.
- Biofuels, metabolites, and biofertilizers.
- Few Chemicals, Enzymes and other Bioactive Molecules.
- Vaccines and other Antibiotics to kill or retard the growth of disease-causing microbes.
- Let us know in detail about the role of microbes in industrial products.

Beverages

- Yeasts are the widely used microorganism for the production of beverages like beer, brandy, rum, wine, whiskey, etc.
- Yeasts are single-celled, eukaryotic, microorganisms of the Kingdom Fungi.
- In these industrial process, the species of yeasts, Saccharomyces cerevisiae, generally called as the Brewer's Yeasts are used for fermenting fruit juices and malted cereals to produce ethanol.
- Once after the fermentation, these beverages are distilled to produce both Alcoholic and non-alcoholic beverages including whiskey, brandy, rum, etc.

Organic acids

- Microbes are also used for the industrial production of certain organic acids.
- Citric acid was the first discovered organic acids from microbial fermentation of lemon – a citrus fruits.
- Organic acids are also produced directly from glucose.
- Aspergillus Niger, Acetobacter acute and Lactobacillus are few examples of microbes used for the industrial production of organic acids.

Enzymes

- Enzymes are naturally occurring, biological catalysts that are mainly used to control certain biochemical reactions in the living system.
- Enzymes have a wide range of applications in the production of both medical and non-medical field.
- Apart from the plants and animals, enzymes are also obtained from certain microbes and are referred to as the microbial enzymes
- Microorganisms are majorly used for the production of industrial enzymes through the safe gene transfer methods
- The first industrially produced microbial enzymes were obtained from the fungal amylase in the year 1896 and were used to cure indigestion and several other digestive disorders.

Antibiotic

- Antibiotics are chemical substances produced by certain microbes which functions either by killing or retarding the growth of harmful microbes without affecting the host cells.
- Penicillin was the first antibiotic to be discovered by Alexander Fleming in the year 1928 from the fungus Penicillium notatum.
- There are many other antibiotics produced by microorganisms, including Streptomycin, and other antibiotics used to treat a number of bacterial infections.