

Bacteria as Important Phytopathogen

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Abstract

Phytopathogenic organisms play a vital role in economic losses and impacts the environment from which bacteria plays a crucial role. Collectively they cause losses more than one billion dollars worldwide every year. Together with other pathogens such as viruses, fungi and factors like biotic stress and abiotic stress including environmental degradation pose a threat to world. Thus, development of management practices to overcome phytopathogenic bacteria plays a very crucial role. Therefore, understanding biology, survival, dissemination of phytopathogenic bacteria becomes necessary.

Key Word- Biology, Dissemination, Phytopathogenic bacteria, Survival

Introduction

Bacteria are single celled microorganism, extremely minute, rigid unicellular and devoid of chlorophyll. Considering ultra-structure of bacteria, its size ranges from 0.2 μm to 250 μm . Small size of bacteria has two important consequences. One is it increases physiological activity of bacteria and second is it limits enzymatic activity. Due to small size of bacteria, it can easily enter through vascular bundles giving a systemic appearance of symptoms. Bacteria cell wall is not made up of cellulose except *Acetobacter*, *Zymosarcina* sp. It is made up of peptidoglycan. Due to high surface to volume ratio, It has high physiological activity and so as high growth rate. The adaptive nature of enzyme production is one of the greatest virtue of bacteria. It synthesizes organic polymers which have deposited outside the cell wall as loose or more amorphous layer called capsule or slime layer. This protects bacteria from hostile environment.

Basic Biology

Bacteria have several morphological shape like bacilli (rod), cocci (spherical), pleomorphic, rod (irregular shape) and spiral. Majority of plants are associated with rod shape. Cell wall of bacteria contains murein which provides mechanical strength to the

protoplast and protect it from osmotic lysis. Due to production of sticky substance from slime layer, it attaches to the soil surface easily which helps bacteria to be transported from one part to other. Bacteria are capable of forming a range of sporulation structures but the main is endospore. Spores are resting bodies produced by some species of bacteria within the cell. However endospore is formed only in the gram +ve bacteria. The free endospore is metabolically inactive and may retain viability for several years. This dormancy is known as cryptobiosis. So endospores are highly heat resistant and tolerant to UV light, ionizing radiations, toxic chemicals etc. One or more chromosomal DNA are present which are coiled. Plasmid is thickly coiled, circular, closed ds DNA. Some transposable elements are also present inside the cell of bacteria. These are free DNA which can change their site or position from chromosomal DNA to plasmid DNA and vice versa. Some of bacterial cell bear appendages like flagella for movement, fimbriae, pili (small thread like). Most of the plant pathogenic bacteria grow well between 25-30° C except *Pseudomonas* which has optimal growth at 35-38° C and *Clavibacter* 20-25° C. Thermal death point i.e. the temperature at which the organism is killed in 10 minute exposure, of bacteria is 50-55° C. The growth of bacteria if drawn in a graph shows lag phase followed by log/exponential phase, stationary phase and finally death phase. Sometime it may show diauxic growth i.e. two growth curve. This occurs when bacteria is provided with two substrate, it uses one substratum followed by the other. Gene transfer in case of bacteria occurs through process of transformation, transduction and conjugation.

Survival of phytopathogenic bacteria

In seed, most species of *Xanthomonas* and *Clavibacter* are seed borne having only limited soil phase. Depending on seed storage conditions, *Xanthomonas axonopodis* pv. *phaseilo* can survive in bean for 3-5 years. *Pseudomonas syringae* (bacterial speck of tomato) can survive in tomato seed for 20 years and remain infective. These are due to high rate of multiplication and easy dissemination. Often weed seeds are an important source of survival and transmission of phyto-bacteria. Success of seed borne bacteria is dependent on their location in the seed. Once the bacteria gain entry to the testa, through hilum, micropyle or threshing injuries, they have easy access to vascular elements in such seeds. Generally, bacteria are called soil invaders rather than soil inhabitants. In plant residues, lesion bearing fallen leaves and twigs on surface of soil provides inoculum for bacteria. *Xanthomonas*

campestris pv campestris survive in infected cabbage stem tissue for 244 days. In soil, bacterial plant pathogen inhabiting in the aerial parts of the host reach the soil through diseased plant debris, rain drop, sprinkler irrigation. Bacteria colonize the underground plant parts such as tuber, bulb, roots then released in the soil with disintegration of these parts. Few pathogens are truly saprophyte with permanent soil phase. This group of soil saprophytes includes rhizosphere. Ex. *Pseudomonas* causing soft rot, some species of *Bacillus*. In perennial host, bacteria survive in canker, buds, systematically inside other host. With insect, *Erwinia carotovora* can live in all stages of seed corn maggot and persist in the intestinal tract in spite of its ability to survive through tubers and soil.

Dispersal of phytopathogenic bacteria

It is of two types. In direct, dispersal by soil, by seed and planting materials occurs while in case of indirect, dispersal involving role of men, insects, other animals occurs.

Mode of entry & Mechanism

Bacteria pathogen enters indirectly inside the host plant. For ex. In soft rot, bacteria enter through wounds, multiply intercellularly and establishes themselves. It dissolves middle lamellae and cell wall through secretion of various enzymes. This is followed by plasmolysis and death of the cell. Unlike virus which grows upon living cells only, bacteria grow upon dead cell of plant tissue by secreting different enzymes. In wilt, bacterial invasion occurs through stomata, hydathode or wound leading to multiplication which ultimately concentrates and multiplies in vascular system. Slimy mass obstructs the flow of water in conducting tissue results in drying of the leaves.

Symptomatology

Symptom of bacterial pathogen varies from wilt to gall or distorted plant parts. Most common are spot on leaves, stems or tree trunk, rot of any part of plant etc.

Summary

Plant pathogenic bacteria differ from other non-pathogenic organisms in being able to cause diseases. As bacteria plays a crucial role in disease development followed by huge economic losses, it becomes very important to have a vast knowledge on survival, dissemination of phytopathogenic bacteria.

Reference

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