

CELLULOSE DEGRADING BACTERIA

CELLULOSE DEGRADATION PROCESS

- Cellulose is a complex polysaccharide comprised of thousands of d-glucose subunits (Six Carbon Sugar)
- Cellulose is the structural component of primary cell wall in plants, most abundant organic compound on earth
- Cellulolysis is a biological process mediated by a select group of extracellular enzymes called cellulases
- Three specific cellulase enzymes (secondary metabolites) mediate cellulolysis (conversion of cellulose > glucose)
 - 1, 4- β -endoglucanase (cleaves of β -1, 4-glycosidic bonds along a cellulose chain)
 - 1, 4- β -exoglucanase (cleaves non-reducing portion of chain & splits fibrils from crystalline cellulose)
 - β -glucosidase (hydrolyzes cellobiose and water-soluble cellodextrin to glucose)

UTILIZATION OF GLUCOSE BY OTHER ORGANISMS

- When Cellulolysis occurs (hydrolysis of cellulose) glucose can be utilized by organisms as a readily available carbon source
 - Release of carbon is then utilized by Beneficial Soil Organisms to drive metabolic functions (energy source)
 - Catabolism of cellulose contributes to carbon cycling in the soil profile

UTILIZATION OF GLUCOSE BY PLANTS

- Taken up by sugar transport proteins and assimilated into plants
- Can be utilized as immediate energy source (tagged), stored for later use (sink), precursor to structural carbohydrates (polysaccharides)

HEMI-CELLULOSE DEGRADING BACTERIA

HEMI-CELLULOSE DEGRADATION PROCESS

- Hemi-cellulose is a polysaccharide comprised of a variety of sugar monomers (xylose, mannose, galactose, rhamnose, arabinose)
 - Hemi-cellulose is bound to cellulose by pectin forming a network of cross-linked fibers in cell wall
 - Xylan is major component of hemi-cellulose in higher plants
- * Degradation process mediated by enzymes (secondary metabolites) endo- xylanase & B-xylosidase (extracellular enzymes)

UTILIZATION OF XYLOSE BY OTHER ORGANISMS

- Release of carbon is then utilized by beneficial soil microorganisms to drive metabolic functions (energy source)
 - Bacteria utilize xylose via xylose isomerase, Fungi utilize xylose via oxidoreductase

LIGNIN DEGRADING BACTERIA, ACTINOBACTERIA & FUNGI

LIGNIN DEGRADATION PROCESS

- * Lignin is a heterogeneous, phenolic and polydisperse biopolymer which resists degradation due to its aromatic and highly branched structure
- * Bacteria, actinobacteria and fungi have the capacity to degrade lignin a process once attributed to only fungi
 - * Bacterial enzymes start the process by depolymerizing lignin through peroxidases
- * The aromatic compounds resulting from lignin depolymerization are then catabolized by bacteria enzymes (laccases)
- * Lignin is considered a major component of soil organic matter due to its high stability and low degradability lignin contributes to increasing humus formation

BENEFITS OF HUMUS

- * Nutrient retention, moisture retention, enhanced aeration and drainage, improved soil structure, increased cation exchange capacity, buffers soil pH
 - Bacteria utilize xylose via xylose isomerase, Fungi utilize xylose via oxidoreductase