Soil Biology And Biochemistry (SOIL-506)

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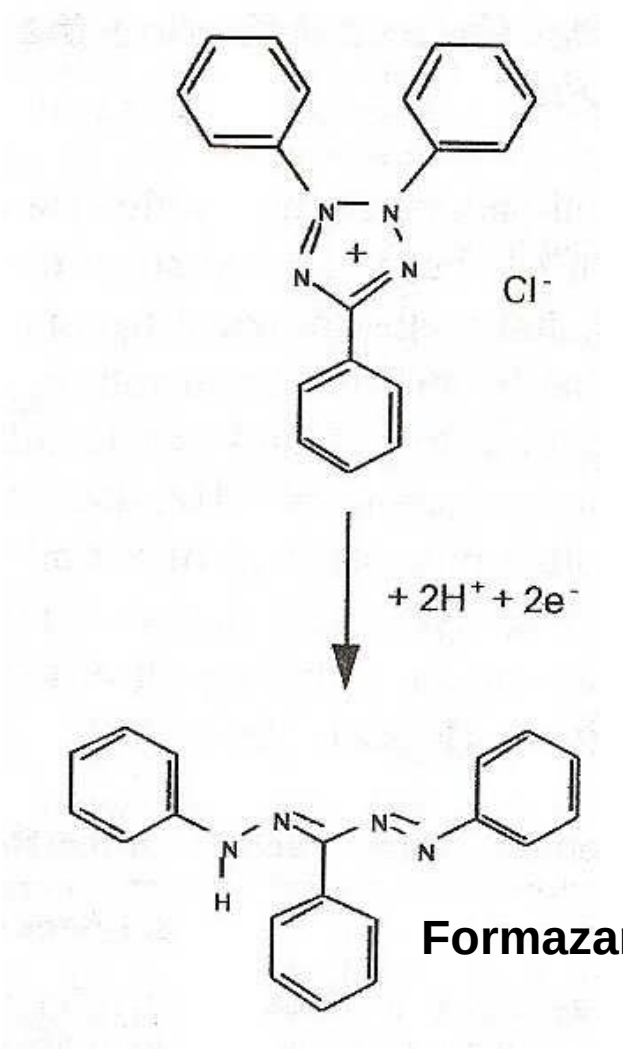
SOIL ENZYMES

Soil Enzyme	Reactions	Functional role
Dehydrogenase	Electron transport system	C - cycling
ß-glucosidase	Cellobiose hydrolysis	C - cycling
Cellulose	Cellulose	C - cycling
Phenol oxidase	Lignin hydrolysis	C - cycling
Urease	Urea hydrolysis	N-cycling
Amylase	N-mineralization	N-cycling
Phosphatase	Release of PO_4^-	P-cycling
Arylsulphatase	Release of SO_4^-	S-cycling
Soil enzymes	Hydrolysis	General organic matter degradative enzyme activities

Dehydrogenase Activity

Tetrazolim Chloride



Formazan

Measures biological activity of soil

Soil activation is determined indirectly, using hydrolytic reaction leading to formazan evolving.

The formazan concentration is directly proportional to microbial activity

Phosphatases

Involved in P cycles

Good indicator of soil fertility

Under P deficient conditions, acid phosphatase secretion from plant roots is increased to enhance the solubilisation and remobilization of phosphate, thus influencing the ability of the plant to cope with P-stressed conditions.

Acid phosphatase activity increased by 30-40% in mycorrhiza inoculated soil which is primarily responsible for the improved availability of rhizospheric P besides Zn.

Rhizospheric Biochemical Changes

Zn levels (kg/ha)	Biomass C (%)		Dehydrogenase (Δ in OD at 485 nm)		Acid Phosphatase (µmol PNP/g/30min)	
	M-	M+	M-	M+	M-	M+
0	0.045	0.054	0.369	1.362	0.510	0.559
5	0.036	0.045	0.379	1.505	0.508	0.563
10	0.036	0.045	0.385	1.527	0.505	0.570
M	0.011		0.043		0.011	
Z	NS		0.068		NS	
M x Z	NS		NS		NS	

Subramanian et al. 2010

Urease

Hydrolysis into NH_3 and CO_2 with the concomitant rise in soil pH

Originates mainly from plants and microorganisms found as both intra- and extra-cellular enzymes.

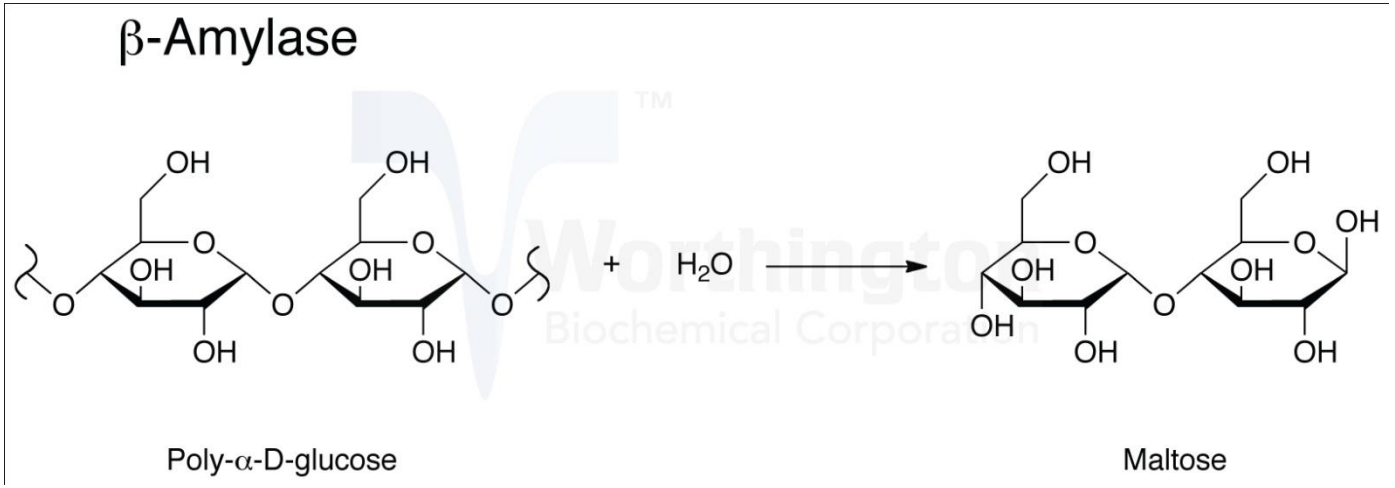
Plants or microorganisms derived urease rapidly degraded in soil by proteolytic enzymes.

Major part is extracellular urease, which is stabilized by immobilization on organic and mineral soil colloids.

Affected by cropping history, organic matter content of the soil, soil depth, soil amendments, heavy metals and temperatures.

Amylase

Starch hydrolyzing enzyme



Types α - amylase and ß-amylase

Tα – amylases are synthesized by plants, animals and microorganisms, whereas, ß-amylase is synthesized mainly by plants.

Influenced by cultural practices, type of vegetation, environment and soil types.

Arylsulphatases

Hydrolysis of sulphate esters in the soil

Secreted by bacteria into the external environment as a response to sulphur limitation

Hydrolysis of aromatic sulphate esters (R-O-SO_3-) to phenols (R-OH) and sulphate, or sulphate sulfur (SO_4 or SO_4-S).

ß-Glucosidase

Predominant enzyme in soils

Involved in catalyzing the hydrolysis and biodegradation of various ß-Glucosidase present in plant debris decomposing in the ecosystem.

Its final product is glucose, C energy source of microbes

Useful as a soil quality indicator

Aglycons - Precursors of the toxic substances, which cause soil sickness where plants are grown as monocrops.

Sensitive to changes in pH and soil management practices

Cellulases

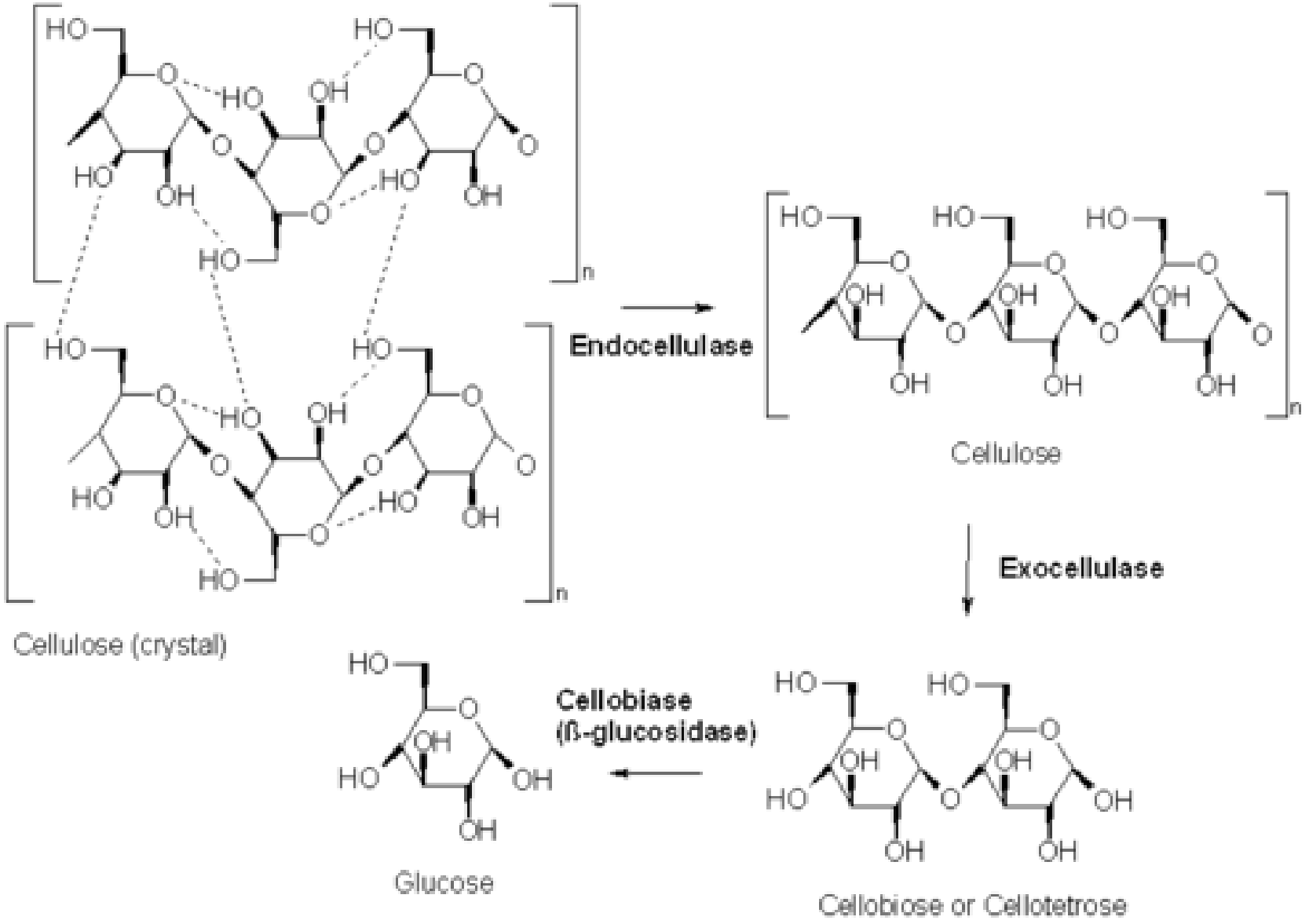
Catalyze the degradation of cellulose, polysachharides built up of ß-1,4 linked glucose units.

Derived mainly from plant debris, and a limited amount from fungi and bacteria in soils.

Affected by temperature, soil pH, water and oxygen contents, the chemical structure of organic matter and its location in the soil profile horizon, quality of organic matter/plant debris and soil mineral elements and trace elements from fungicides.

More stimulatory effect in black soil than red soil.

Cellulases


Cellulose (crystal)
Endocellulase
Cellulose
Exocellulase
Cellobiase
(ß-glucosidase)
Glucose
Cellobiose or Cellotetrose

Chitinase

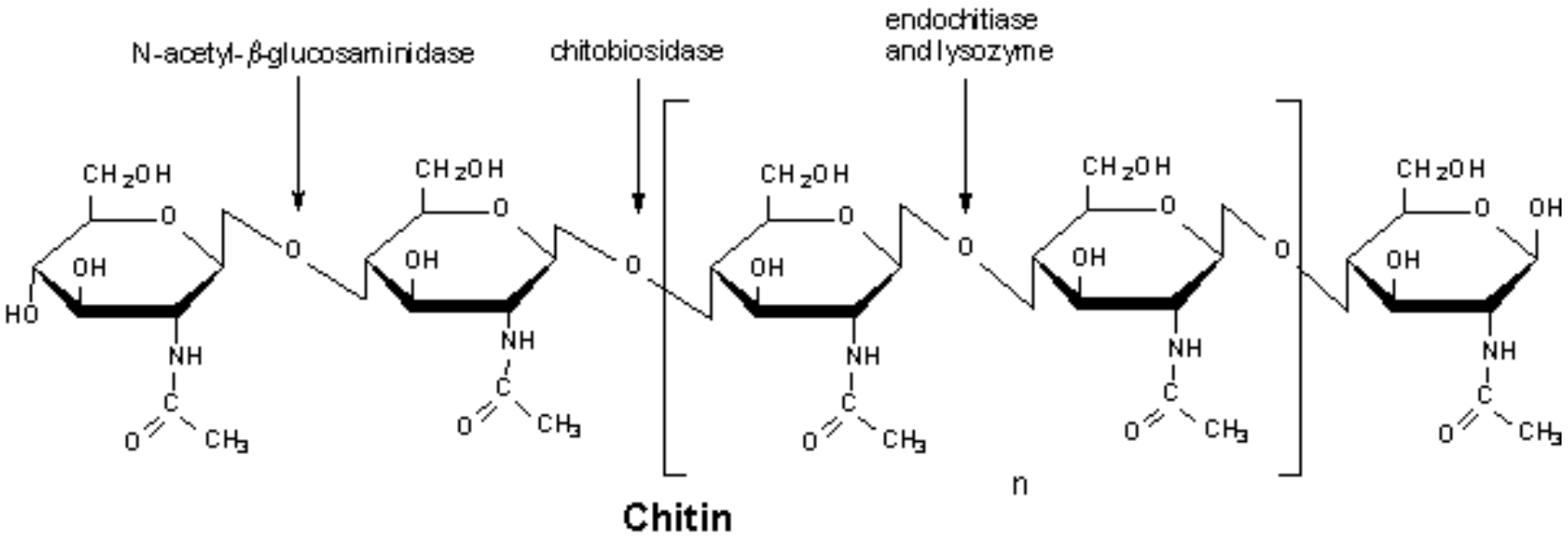
Degradation and hydrolysis of chitin.

Major structural component of many fungal cell wall that use the hyperparasitisim mechanisms against pests/pathogen attack.

These biological agents also reduce disease-producings fungi such as *Sclerotium rolfsii* and *Rhzoctonia solani* in beans and cotton, respectively.

One of the mechanisms proposed involves lytic enzymes chitinase that cause the degradation of cell walls of pathogenic fungi.

Chitase Specificity



Chitin

Polymer of β-(1-4)-N-Acetyl-D-glucosamine units