

Plants

Algae (Green, red, brown, golden, yellow-green; diatoms)
land plants

Cell Walls

Primary cell wall surrounds growing cells and the cells of soft tissues (fruit)

- Slide 1 shows general architecture
- Slide 2 shows schematic of primary cell wall, which consists of cellulose, hemicellulose, pectin
- cellulose: β ,4 linked glucose Slide 3
 - inter and intrachain H-bonding, gives rise to insoluble fibers
 - resistant to degradation
 - synthesized at plasma membrane from NAE
- Hemicelluloses Slide 4
 - Xyloglucans, glucuronoxylan, arabinoxylan, glucuronan
- Pectins Slide 5 Rhamnogalacturonans (RG-I/II)
 - note O-Me, O-acetyl, borate ester
 - extracted from citrus rinds and residue from juice production
 - gel forming, temperature-sensitive

Secondary Cell wall • conducting tissue for H₂O Slide 1

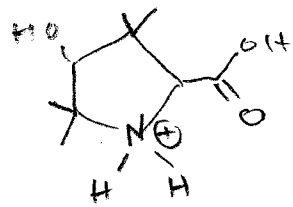
- composed of cellulose, hemicelluloses, lignin
- major component of wood
- nutritional source for livestock (fermentation)
- bulk of biomass convertible to fuel
- engineering to change physical properties and ease of conversion to fuel

N-linked glycans (Slide 6)

- β 2 xylose to core mannose
- α 3 fucose to core GlcNAc
- immunogenic
- Engineering plants to remove α 3 fucose and β 2 xylose and to add Sia

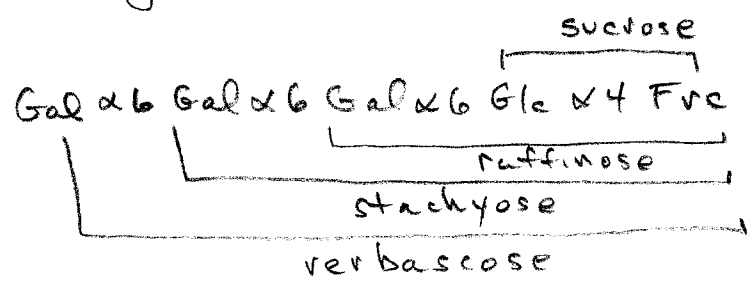
O-linked glycans (Slide 7)

- linked by hydroxyproline



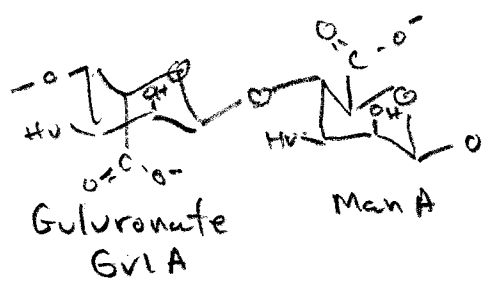
Other glycans of interest

- Raffinose oligosaccharides - in seeds, indigestible due to lack of α -galactase



- Phenolic glycosides
Defense
- Glyceroglycolipids - Gal, Gal \times 1Gal, etc
Thylakoid membrane, required for photosynthesis as complex with PSI and PSII
- Agarose and carrageenans
3,6 anhydro L-gal β 3 Gal
Sulfated galactans

- Alginates
ManA and GlcA



- Fucoidins

Signaling

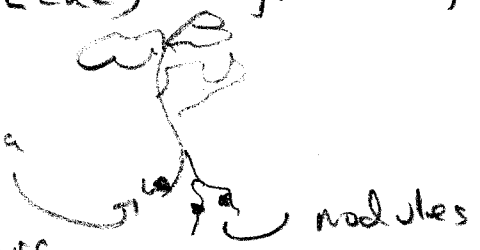
✓ Oligosaccharins are fragments released from pathogen cell walls (PAMPs) and plant walls due to damage (DAMPs)

- eg. oligogalacturonides from RG-II
- chitin oligosaccharides from pathogen

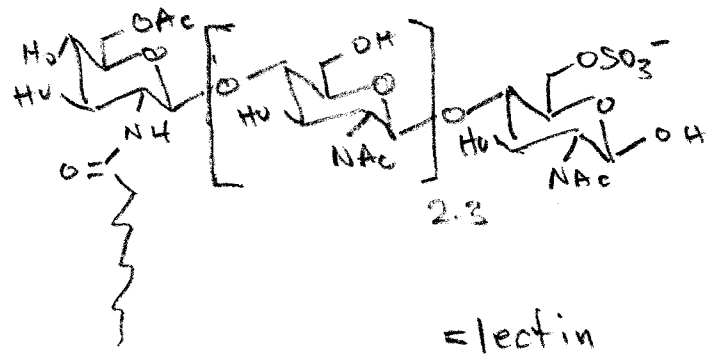
✓ Symbiosis (Rhizobium) - NOD factors

- Leguminous plants (Fabaceae) - eg. beans, alfalfa, etc.

Rhizobial bacteria



Bacteria produce NOD factors
N-acetylated chitin oligomers



- binds to receptors on root hairs, induces deformation of hair and epithelial proliferation allowing colonization

- bacteria get nutrients from plant, fix $N_2 \rightarrow NH_3$

Lectins

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- Handout showing families lectins
- Seed lectins
 - ✓ stable to desiccation
 - ✓ provides food source in germinating plants - storage granules in seed become vacuoles in cotyledons in germinating plant
 - ✓ insecticide, anti-microbial, conditioning of animals to avoid certain plants, toxic to humans
 - ✓ Cook seeds and beans before consumption
- Plant lectins fall into two groups - R-type and L-type
- Most are oligomers and will induce hemagglutination



- ConA - L-type, binds to mannose (Jack Bean)
Slide 8 tetraivalent, x-links receptors and can activate cells
- Ricin - R-type Slide 9 (Castor Bean)
 - AB, B subunit for recognition (Gal & GalNAc)
 - A subunit, glycohydrolase, attacks 60S ribosome
 - B has $K_d \sim 10^{-3} - 10^{-4} M$ for monovalent glycan, but on cell surface binds with apparent K_d of $10^{-7} - 10^{-8} M$
- Specificity of lectins defined not by fold but rather by specific amino acids in loops
- Hundreds of lectins known and available

	Viruses	Prokaryotes	Yeasts/Fungi	Plants	Invertebrate animals	Vertebrate animals
Malectin domains		CBM57 family		Receptor-like protein kinases	Malectin	Malectin
R-type CRD		CBM13 family		Toxins (ricin)	GalNAc Transferases	GalNAc Transferases Man receptor family
B-lectin domains (Bulb lectin domains)		Bacteriocins	Fungal lectins	Monocot mannose binding lectins		Fish toxins
F-type lectins [Fucolectins]		Bacterial fucolectins			Tachylectin 4	Fish fucolectins
Sulfated glycosaminoglycan binding proteins		Heparan, Chondroitin, Dermatan & Keratan Sulfate Binding Proteins			Heparan, Chondroitin, Dermatan & Keratan Sulfate Binding Proteins	
Calnexin / Calreticulin			Calnexin/ Calreticulin	Calnexin/ Calreticulin	Calnexin/ Calreticulin	Calnexin/ Calreticulin
M-type lectins			Mnl1	EDEMs	EDEMs	EDEMs
L-type CRD				Legume lectins	Sorting lectins	Sorting lectins
Chitinase-like lectins				Class V chitinase homologs	GH18 homologs	GH18 homologs
Galectins					Galectins	Galectins
C-type lectins					C-type lectins	C-type lectins
P-type lectins						MRH domain proteins
I-type lectins						I-type lectins (Siglecs)
X-type lectins (fibrinogen domains)						Intelectins
Ficolins (fibrinogen domains)						Ficolins
Hyaluronan-binding proteins (Link domains)						Hyaladherins
PA14 domains		PA14 domains	Adhesins (Epa) Flocculins (Flo)			
Plant-specific lectins				ABA family EUL family GNA family Amaranths Cyanovirin family Hevein family Jacalin family LysM domain lectins Nictaba-like lectins		
Bacterial adhesins			Pilus adhesins Non-pilus adhesins			
Virus attachment factors		Hemagglutinins				