

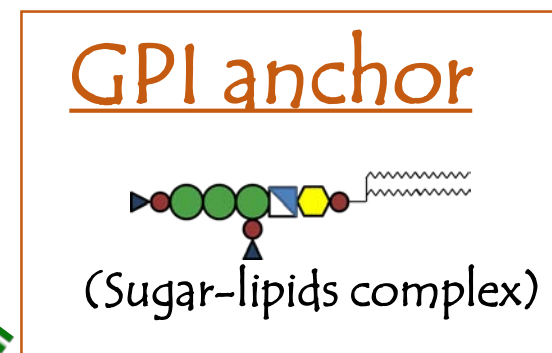
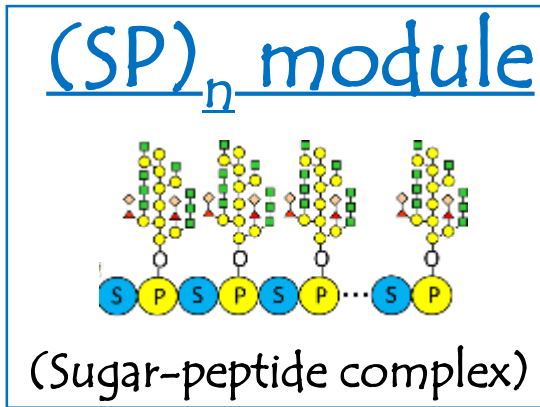
Engineering “designer” biomolecules in plant cells for biomedical and industrial applications

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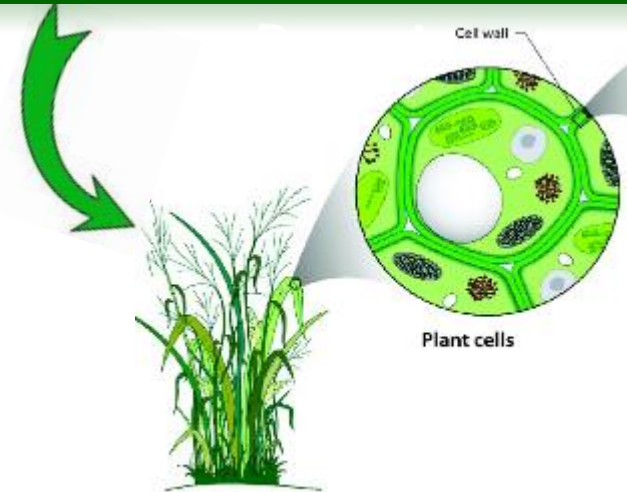
Arkansas Legislative Council Higher Education Subcommittee



"Designer" Biomolecular engineering in plants



I. Molecular pharming
for producing therapeutic proteins in plants
(antibodies, vaccines, growth factors...)



II. Plant cell wall engineering
for improved biomass processability
(biofuel production)

Molecular pharming in plant cells

Plant cell culture is a promising bioproduction platform for biopharmaceuticals



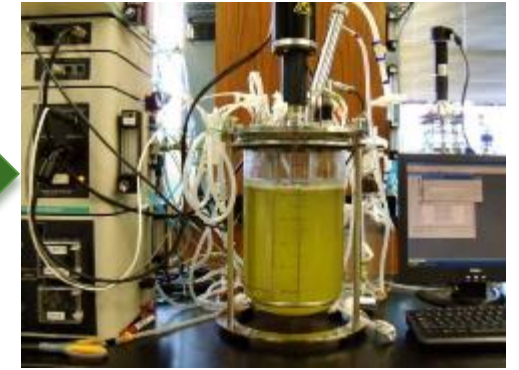
Plant



Callus

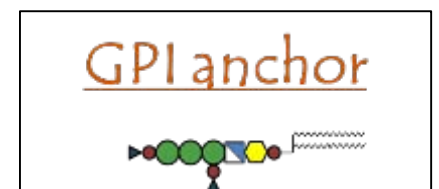
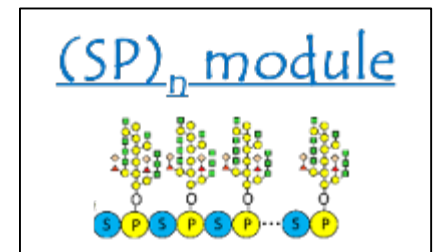


Cell suspension culture



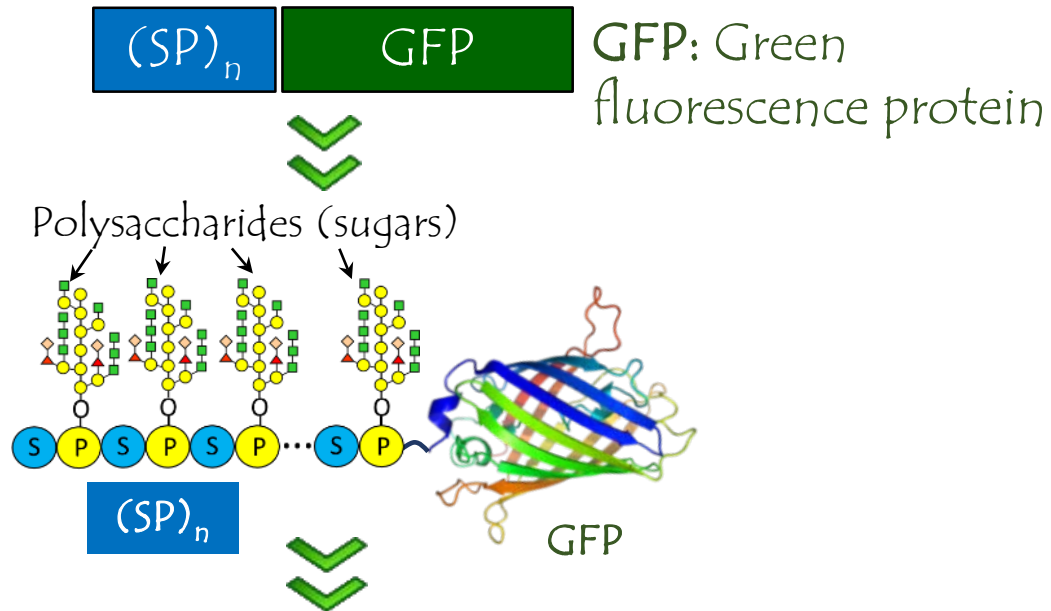
Culture in bioreactor

- ✓ Cost-effective (plant cell culture medium is cheap)
- ✓ Safe (free of animal pathogen and bacterial endotoxin)
- ✓ Easy for purification (if protein is secreted)
- ✓ Capable of making complex proteins (e.g., antibody, vaccines)



(SP)_n module

boosts protein secretion in plant cell culture

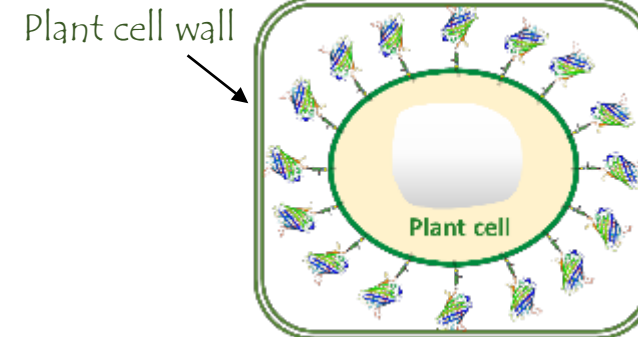
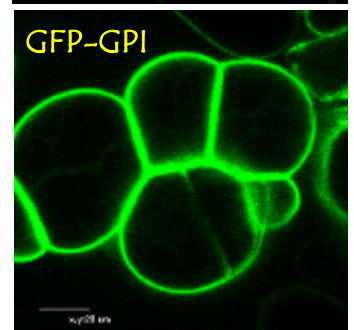
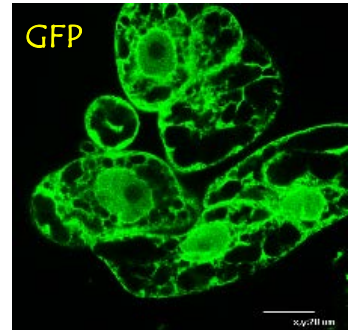
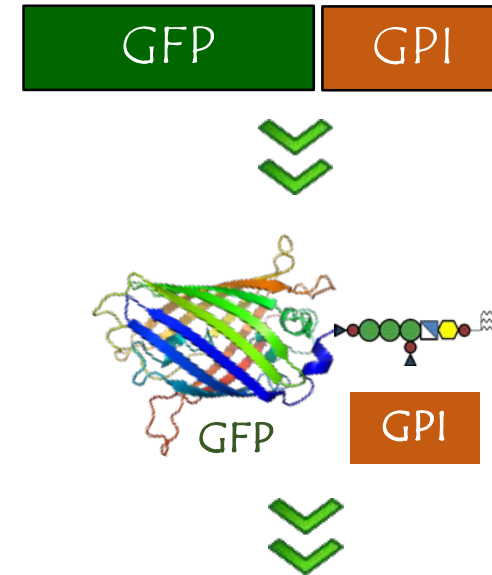


Tobacco cell culture
(viewed by naked eye)

Secreted GFP: ~200 mg/L (2,000-fold increase)

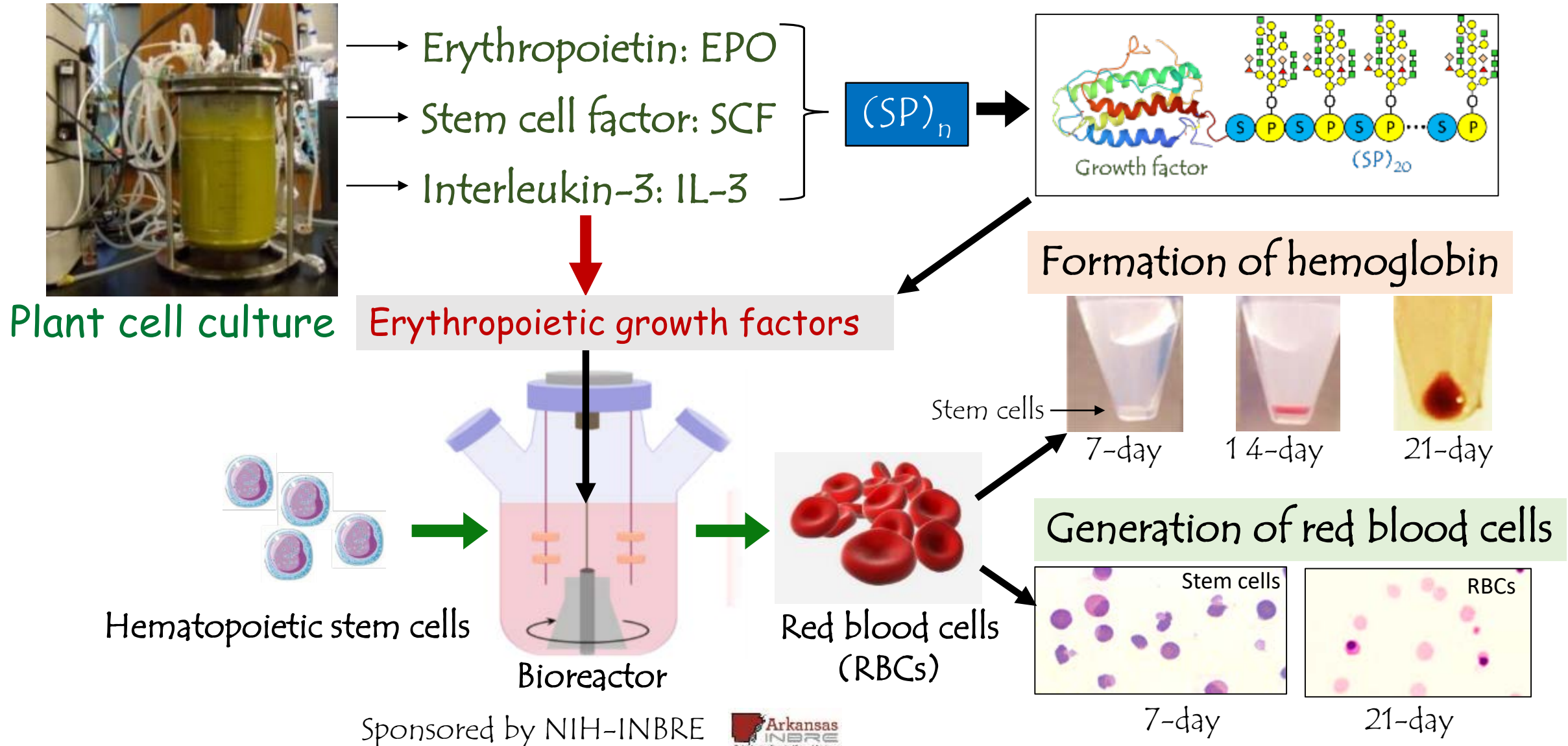
GPI anchor

promotes the translocation of protein to plant cell surface



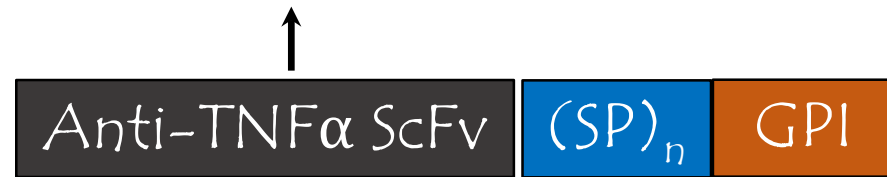
Protein (GFP) displayed at cell surface

Project 1. Plant cell-secreted growth factors for ex vivo production of red blood cells (RBCs)

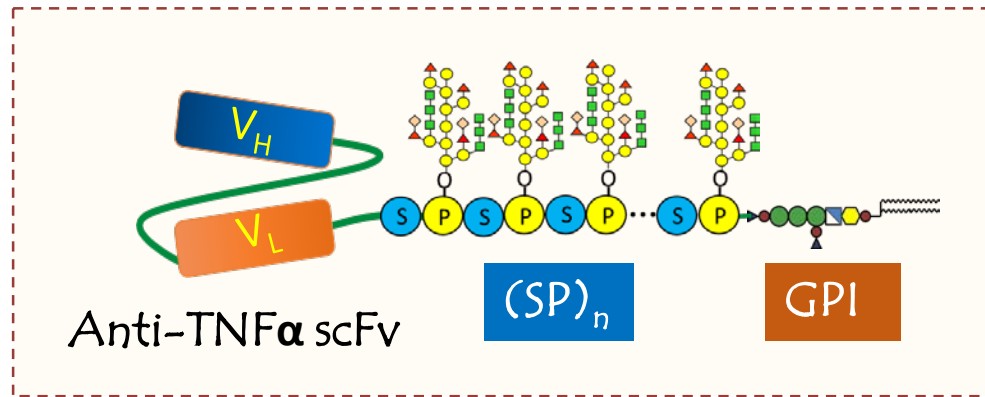


Project 2. Engineering designer biologics in plant cells for oral treatment of Inflammatory bowel disease (IBD)

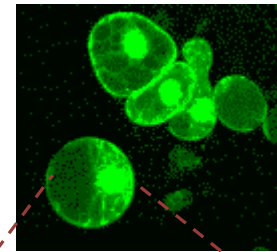
Tumor necrosis factor (TNF α) inhibitor



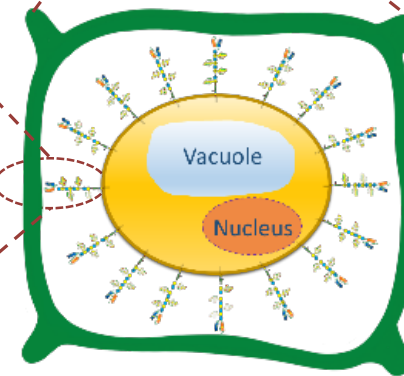
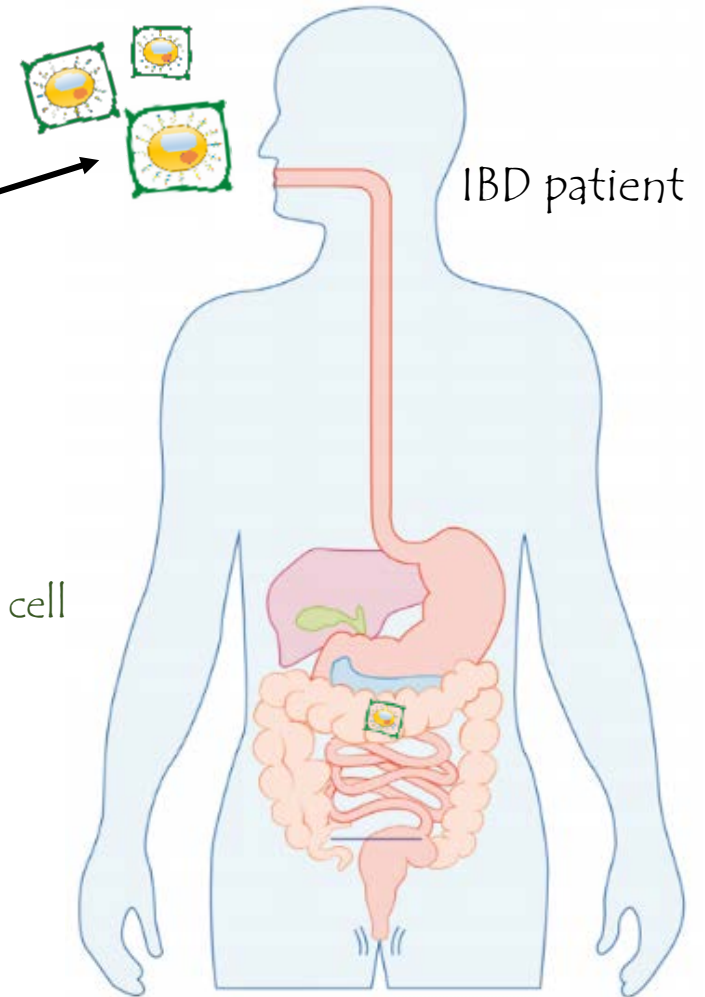
(drug to stop inflammation)



Oral delivery



IBD patient



Tobacco cell

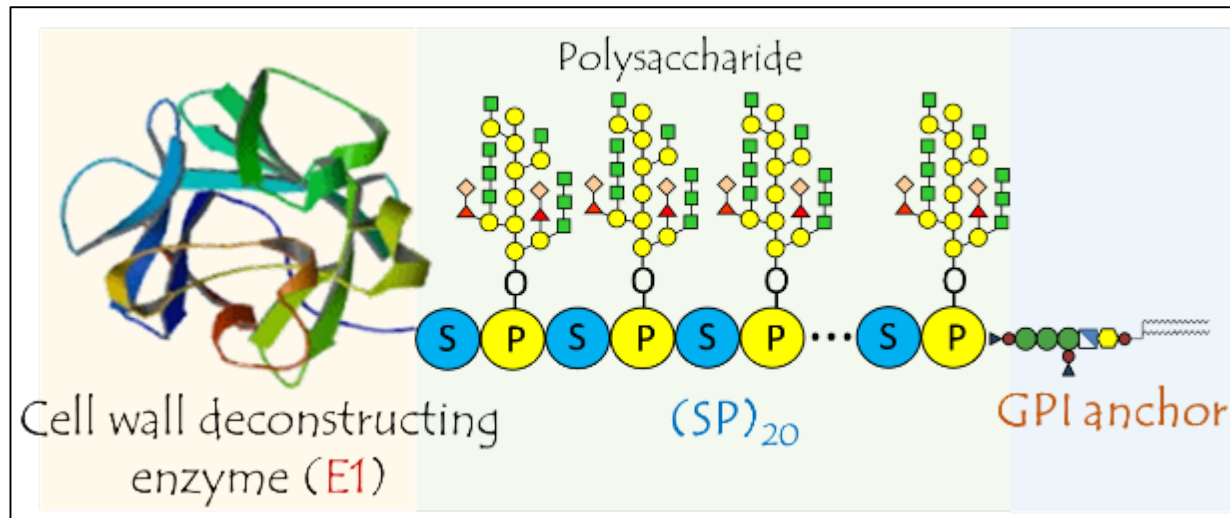
Sponsored by NIH-R15 and NIH-INBRE



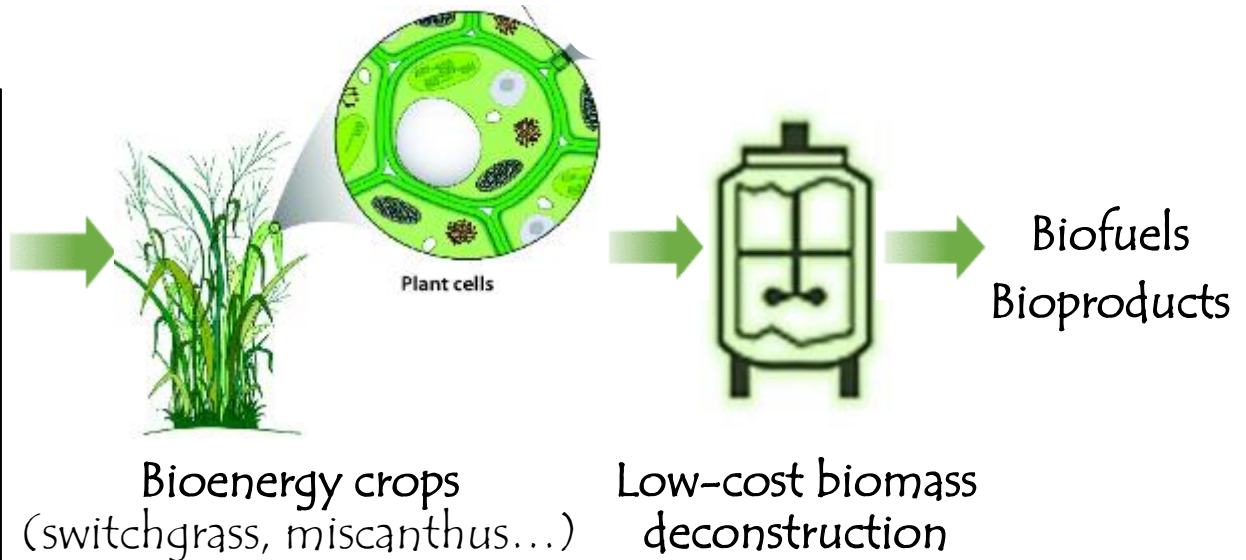
IBD: overproduction of TNF α in colon

Project 3. Genetically engineering plant cell wall for improved biomass processability

Enzyme that breaks down cellulose



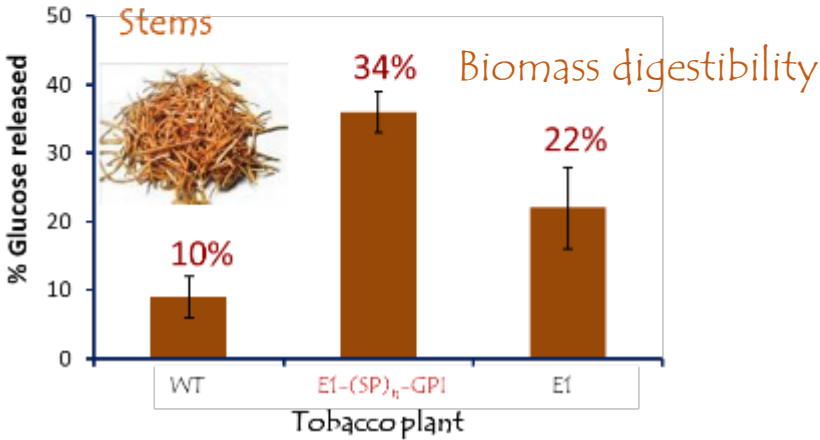
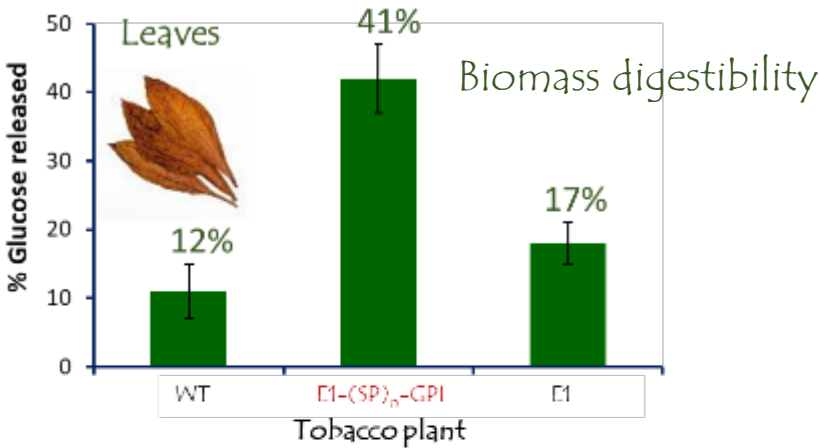
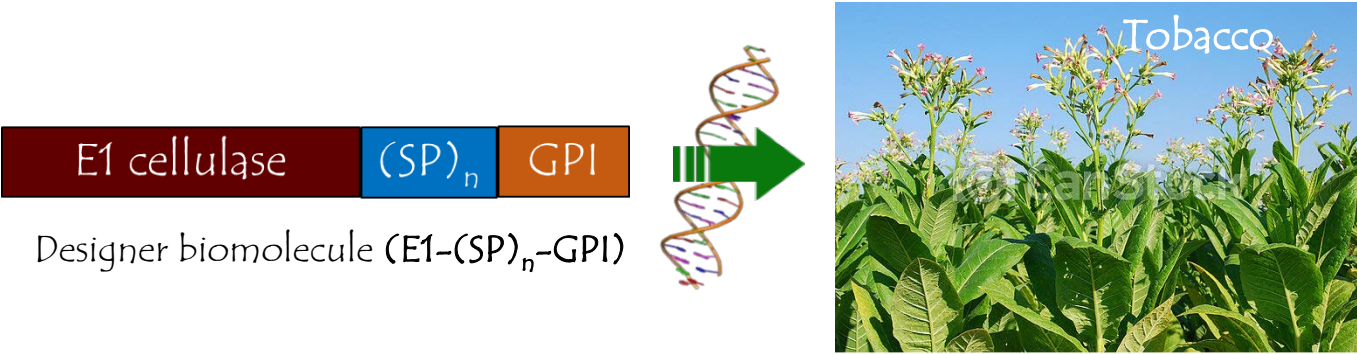
- Efficiently deposit the enzyme (E1) into cell wall matrix
- Stabilize enzyme from degradation
- Intercalate into cell wall biopolymers, loosening cell wall network



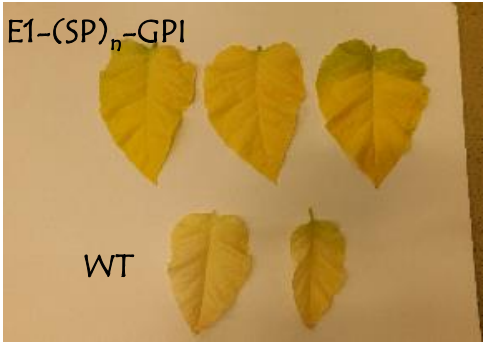
Sponsored by USDA-NIFA



Engineered tobacco biomass showed improved enzyme digestibility



Biomass digestibility is substantially increased



Plant growth was not affected; Transgenic plants grow bigger than the wild-type (WT) plants



Sponsored by DOE-SBIR

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Thank You

