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SCHOOL OF FORESTRY AND WILDLIFE SCIENCES

Nanocellulose/lignin: Possible Bark Beetle Control

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Dr. Lori Eckhardt

AU-FHC Advisory Meeting - FY 17
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Introduction

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Affiliated Center, Forest Products Development Center

Degrees:

BS, Forest Biomaterials

MS, Forest Biomaterials

Licenciate, Analytical Ch

PhD, Forest Biomaterials

Expertise: Peresin spe eractions of plant cell wall components.

Research Interests: and surface science.

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http://wp.auburn.edu/forestproducts/

Traditional Uses of Wood

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HOUSING

Nideröst-House (Switzerland)

COMMUNICATION

Papyrus (Egypt)

TRANSPORTATION

Vasa Ship (Sweden)

Fuel!

Rethinking the use of tres and wood components (and other biomass)

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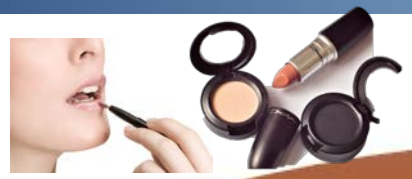

COSMETICS

FOOD

TISSUE ENGINEERING

LIGHT WEIGHT COMPOSITES

MEMBRANES

HOUSING, COMMUNICATION and TRANSPORTATION

FUNCTIONAL FIBERS and PARTICLES

PACKAGING

SMART SENSORS and PRINTED ELECTRONICS

Southern Pine Beetle damage

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www2.ca.uky.edu

www2.ca.uky.edu

www.treefarmsystem.org

www.m
fc.ms.g

Dendroctonus frontalis

entnemdept.ifas.ufl.e
du

Ips engraver

www.barkbe

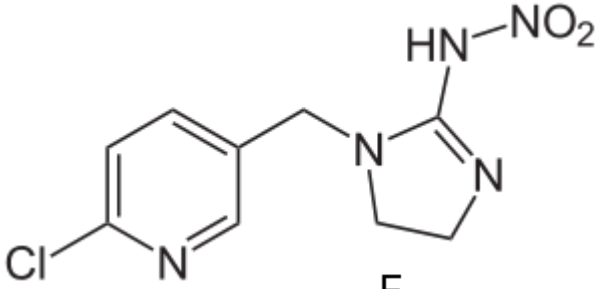
Dendroctonus terebrans

FHDL

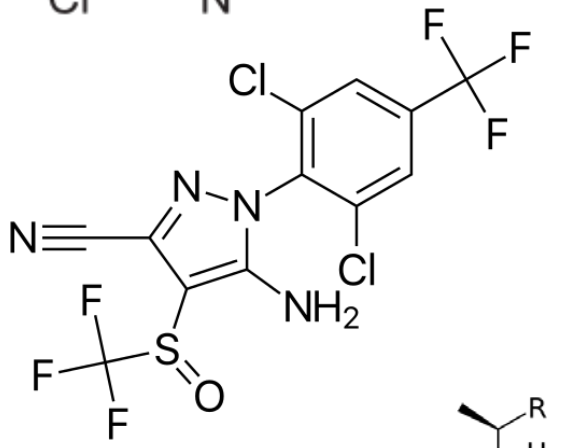
Hylastes spp.

Chemicals currently labeled for bark beetles

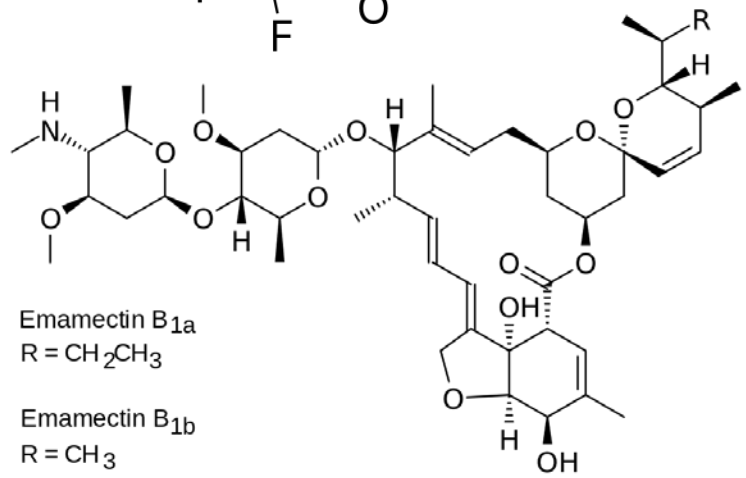
- Imidacloprid
  - Systemic insecticide that acts as an insect neurotoxin
  - Neonicotinoids chemical family → acts on the central nervous system of insects, with much lower toxicity to mammals.



- Fipronil
  - Broad-spectrum insecticide
  - Phenylpyrazole chemical family → disrupts the insect central nervous system by blocking chloride channels.



- Emamectin benzoate
  - Produced by the bacterium *Streptomyces avermitilis*
  - Avermectin chemical family → exhibits toxicity for nematodes, arthropods, and several other pests



A deeper look into biomass

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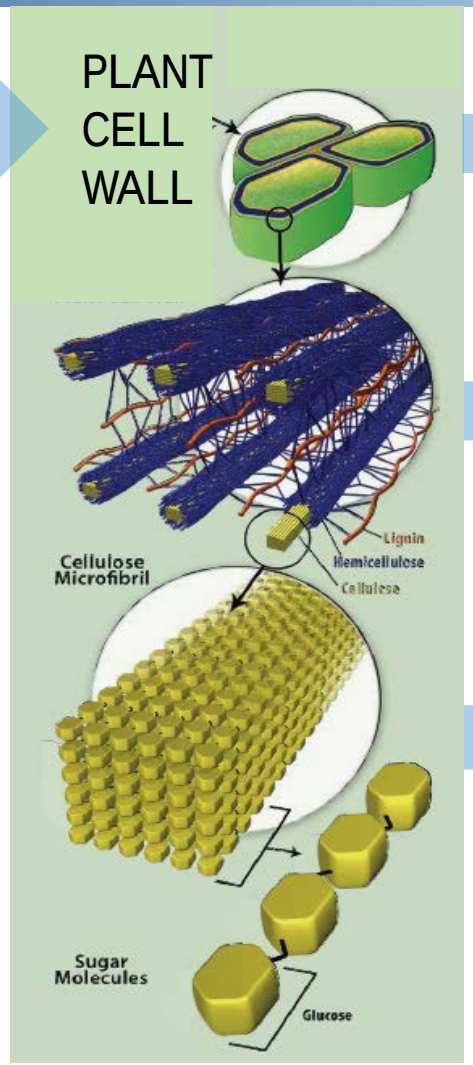
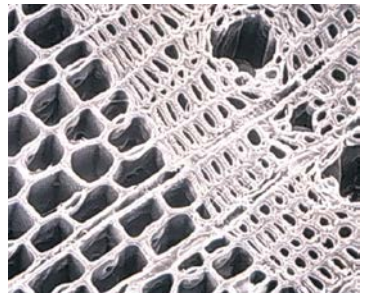
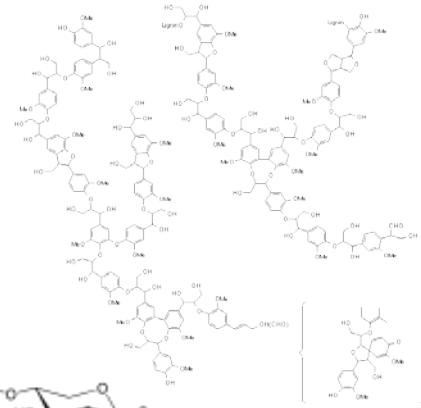
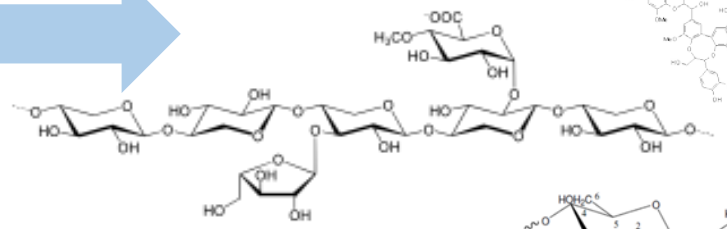
BIOMASS

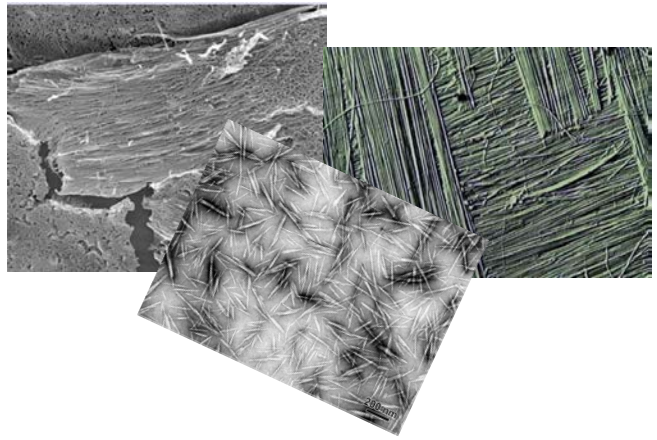


http://www2.lbl.gov/Publications/YOS/Feb/









Nanocellulose and Lignin nanoparticles

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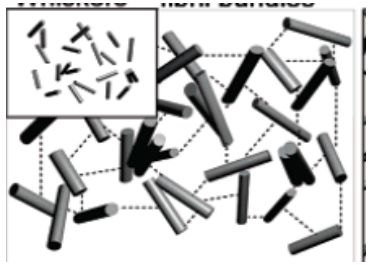
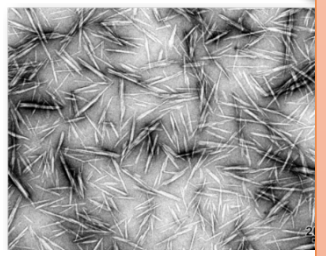
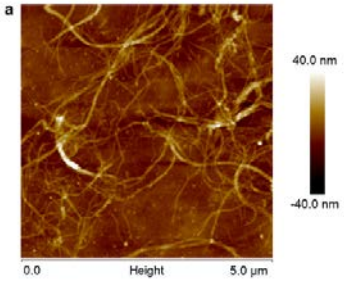
Cellulose nanocrystals (CNC)





Peresin et al. *Biomacromolecules* (2010) 11, p.
Adapted from Pakko et al. *Biomacromolecules* (2007) 8 p.1

Cellulose nanofibrils (CNF)



Pitkänen et al. *Cellulose* (2014) 21 (6) p. 3871
Adapted from Pakko et al. *Biomacromolecules* (2007) 8 p.1934

- Excellent mechanical strength
- High surface-area
- Abundant free hydroxyl and phenolic groups
- High binding capability
- Biocompatibility, biodegradability and sustainability

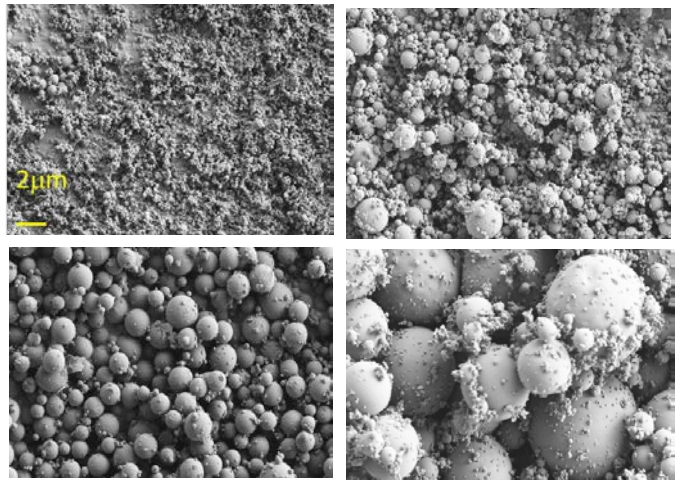
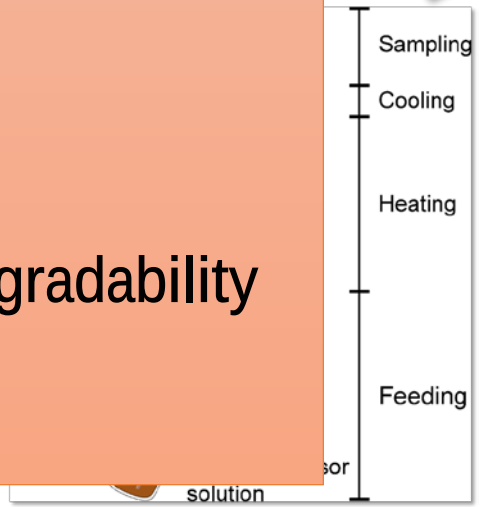
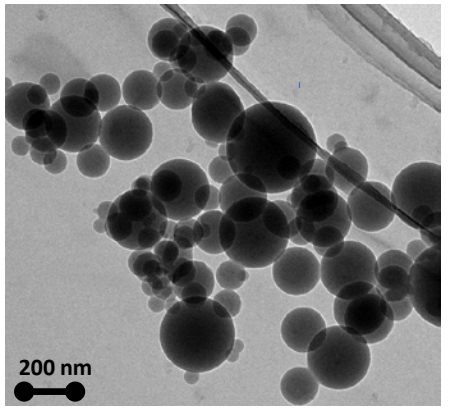


Image courtesy of Dr. Orlando Rojas

Lignin Nanoparticles (LNPs)





ACS Appl. Mater. Interfaces, 2016, 8 23302

Bark Beetle control proposed approach

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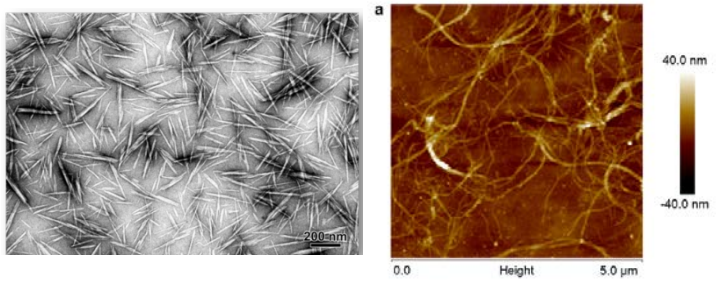
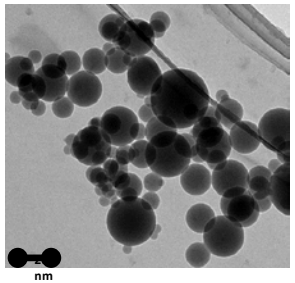
Cellulose nanoparticles (CNPs)



Pitkänen et al. *Cellulose* (2014) 21 (6) p. 3871
Adapted from Pakko et al. *Biomacromolecules* (2007) 8 p.1934

Lignin nanoparticles (CNPs)



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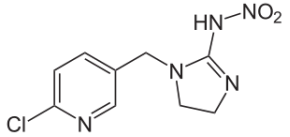
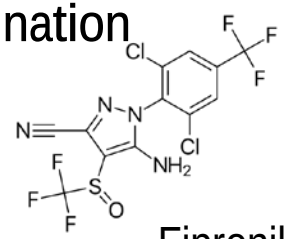
Biocide delivery system (BDS)

- Controlled pest management
- Efficient protection
- Reduced environmental impact

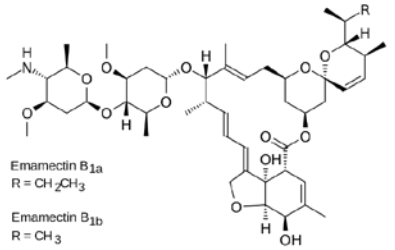
Chemicals impregnation



Imidacloprid



Fipronil



Emamectin benzoate

Sifter/spray

- Sampling of seedlings (needles, stems, roots) at various time points (weekly for 10 weeks).
- Ground tissues will be ground and analyzed to determine movement of pesticide through seedling tissues.

Thank you for your kind attention

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