

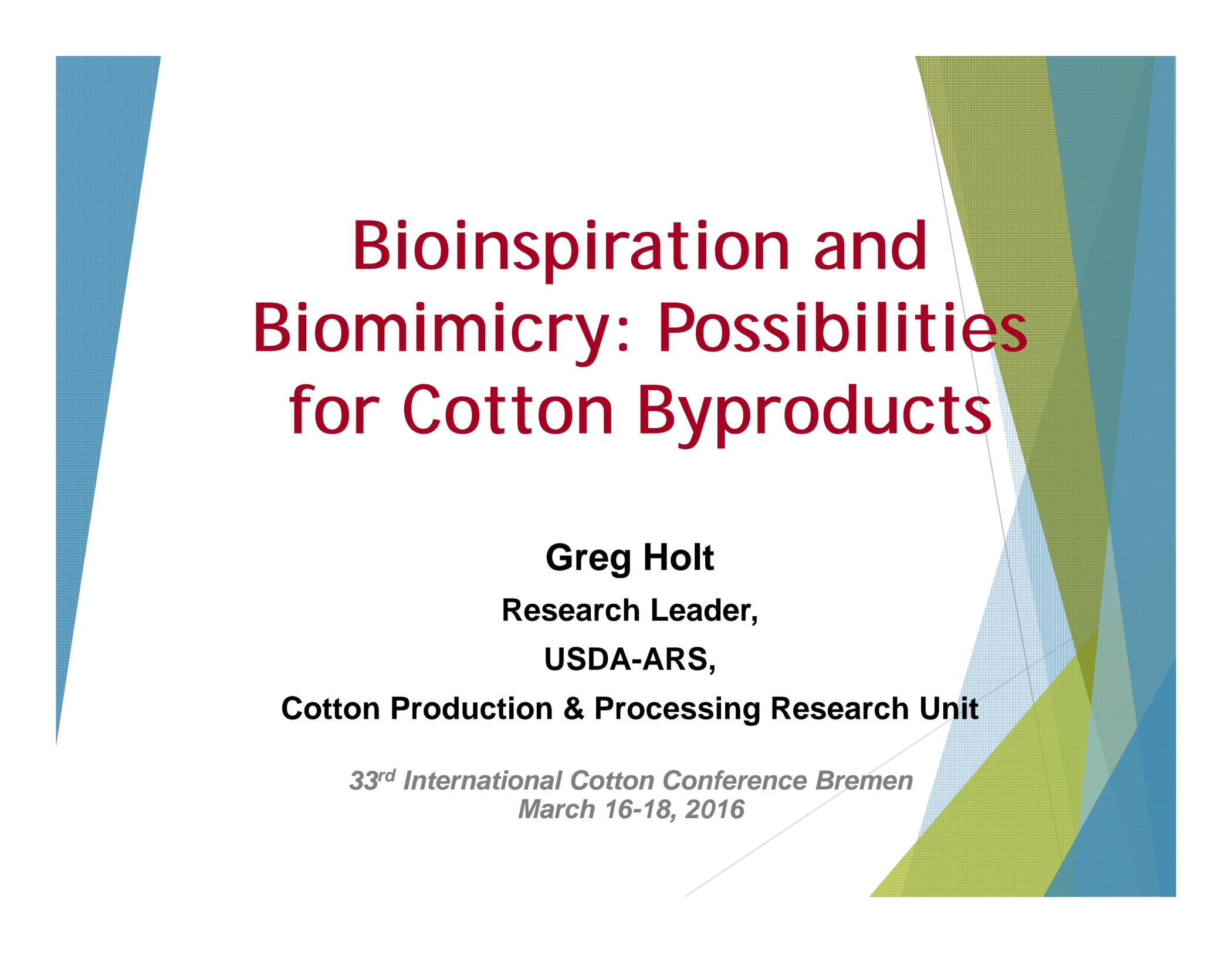
BIOINSPIRATION AND BIOMIMICRY: POSSIBILITIES FOR COTTON BYPRODUCTS

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ABSTRACT

The byproducts from cotton gins have commonly been referred to as cotton gin trash or cotton gin waste primarily because the lint and seed were the main focus of the operation and the byproducts were a financial liability that did not have a consistent market. Even though the byproducts were called “trash” or “waste” they are comprised of cotton plant materials such as lint, leaf, sticks and stems, and carpel. Over the past several years, there have been numerous research endeavors to find markets for or add value to the byproducts to enhance revenue to the processing facility and/or the producer. This presentation focuses on several products produced from cotton byproducts and discusses the pros and cons of their implementation. The presentation ends with a new bio-composite, which has been successfully implemented in industry utilizing fungus mycelium to integrate a plant fiber matrix to create a product for a variety of uses. The idea for the new biocomposite was born from observation of the natural world and encourages bioinspiration and/or biomimicry as a platform for utilizing natural fibers for future composites. Current and potential uses of the mycelium/natural fiber biocomposite will be discussed.



Bioinspiration and Biomimicry: Possibilities for Cotton Byproducts

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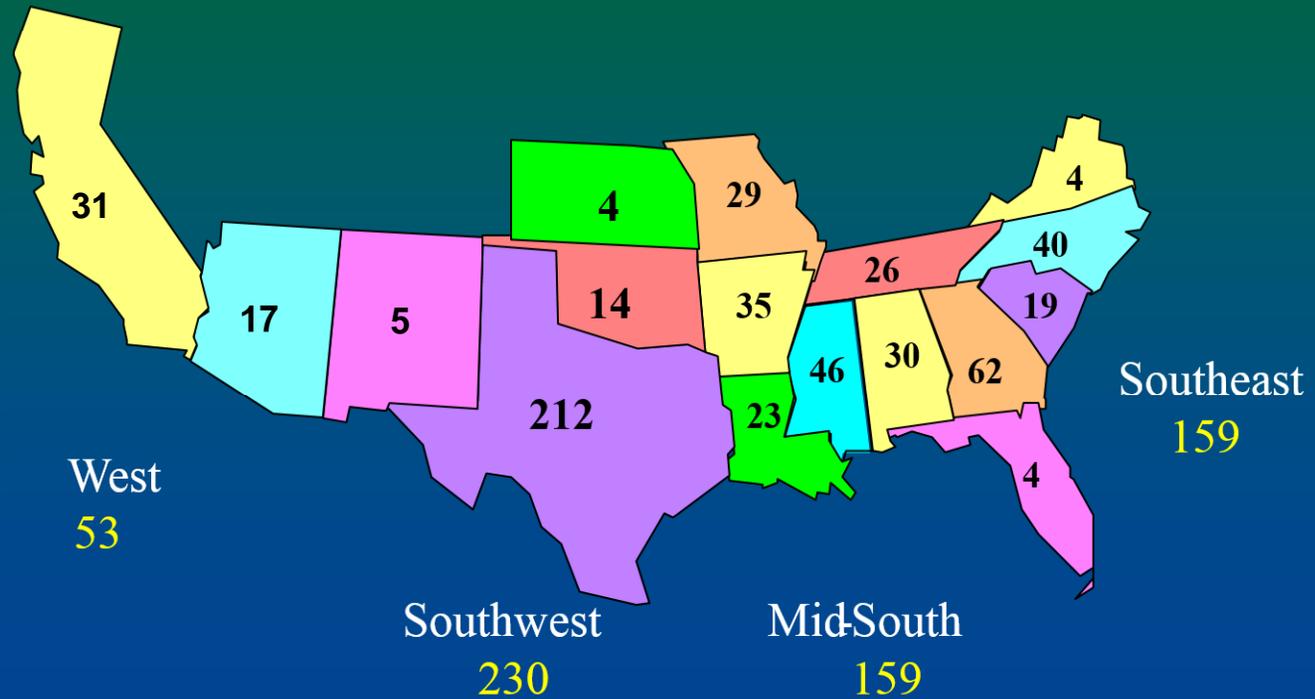
Cotton Production and Processing Research Unit



2014

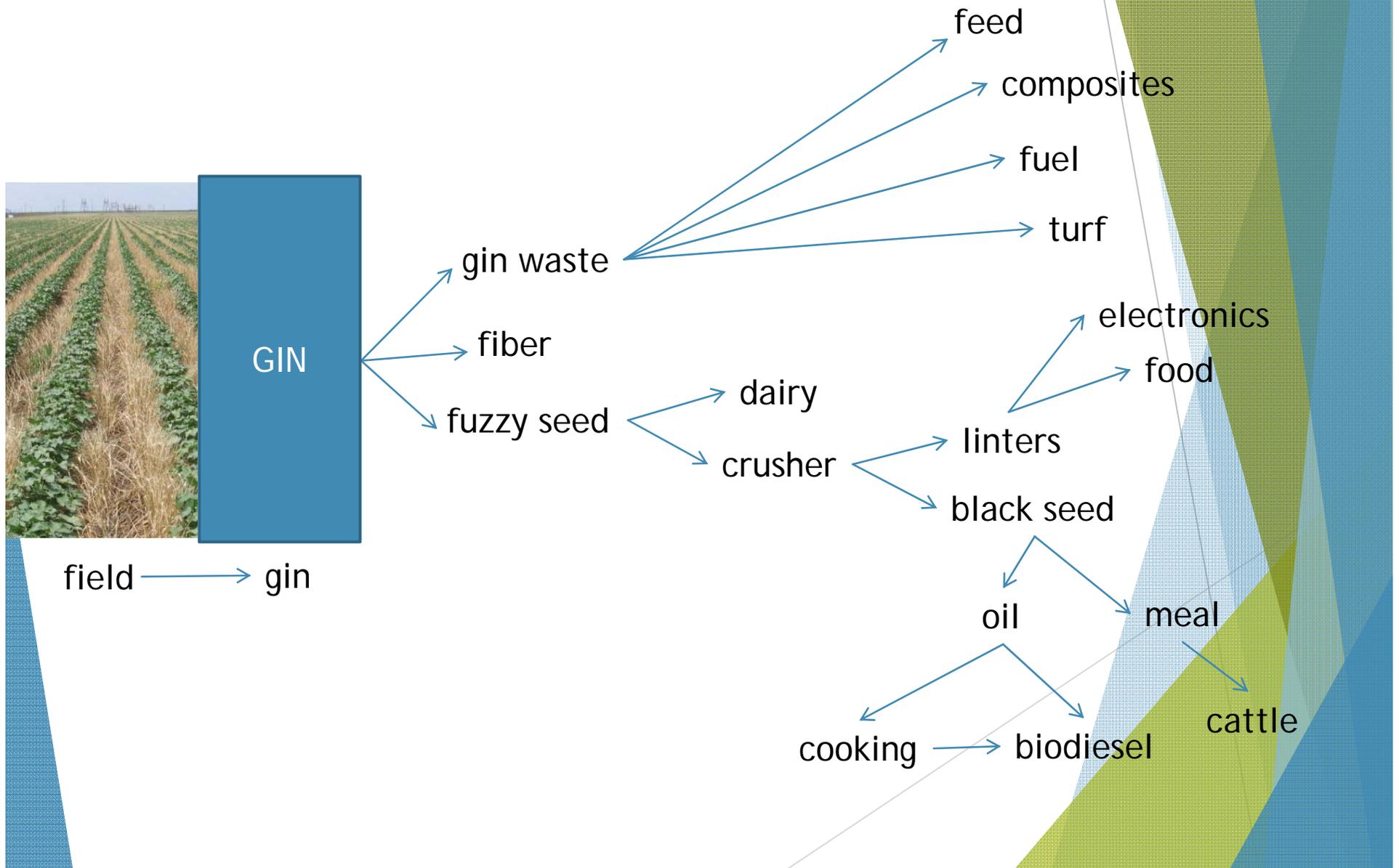
Active Cotton Gins by State

Total Gins: 601

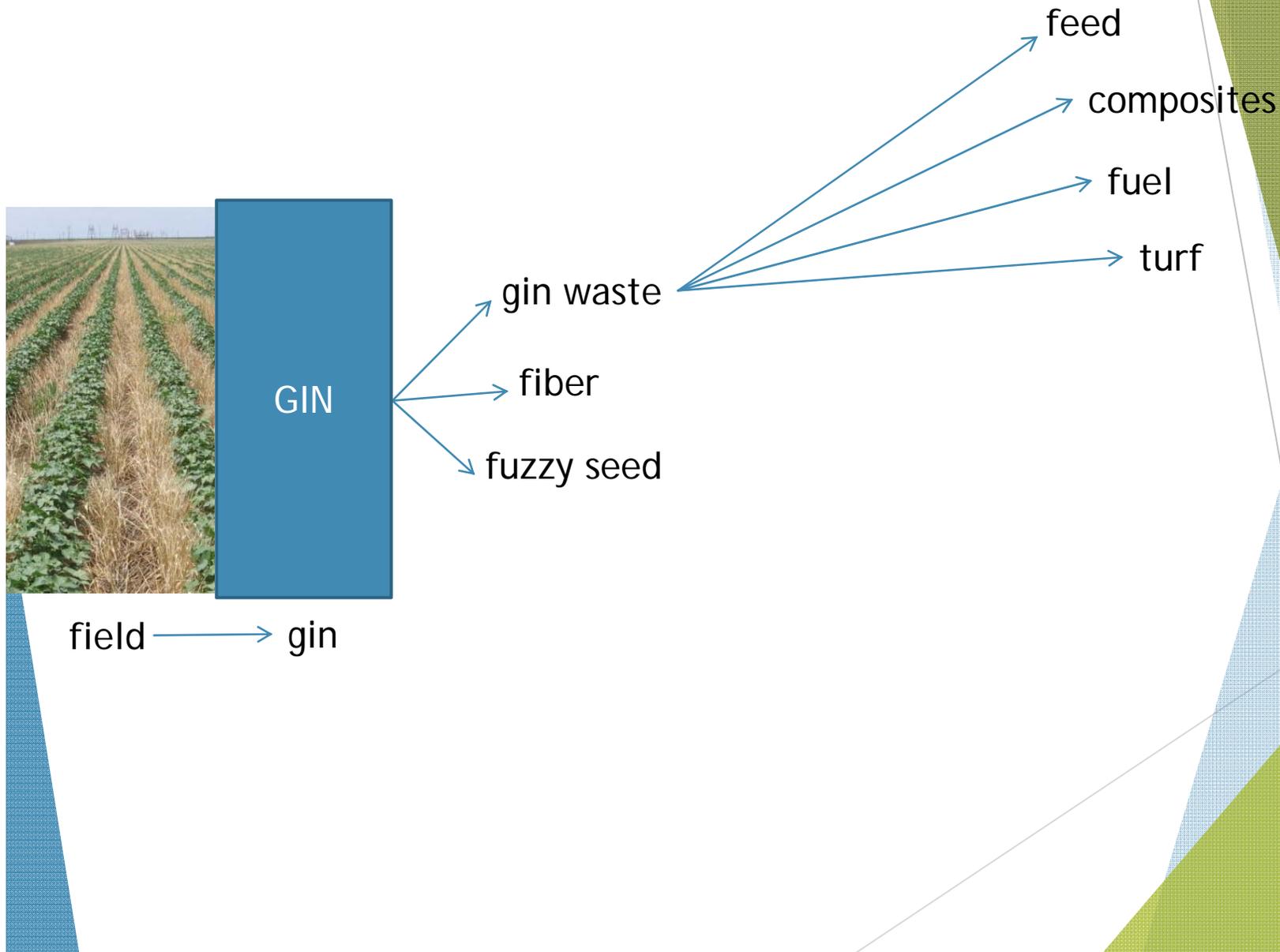


SOURCE: USDA NASS 5/15

Cotton Provides Fiber, Food, Feed, Fuel and Material Feedstocks



Gin Waste → Fuel & Material Feedstocks



Global Cotton Biomass Production

75 Million Metric Tons/Year

80% remains in the Field

10 to 15 MMT Used in Value-Added Products











Sticks



Fines



Burs

Waste Fiber



Raw



Semi-Processed



Re-ginned



Segregation is Key



Applications for Cotton Byproducts

- ▶ Feed
- ▶ Fuel
- ▶ Soil & Turf- Geotextiles, Mulch/Compost (soil nutrients, fertilizer, erosion control)
- ▶ Composites (packaging, acoustic absorbers, furniture cores, etc.)
- ▶ Other (???)

Feed for Livestock

- Agricultural residues can be processed into a high energy roughage for ruminant livestock



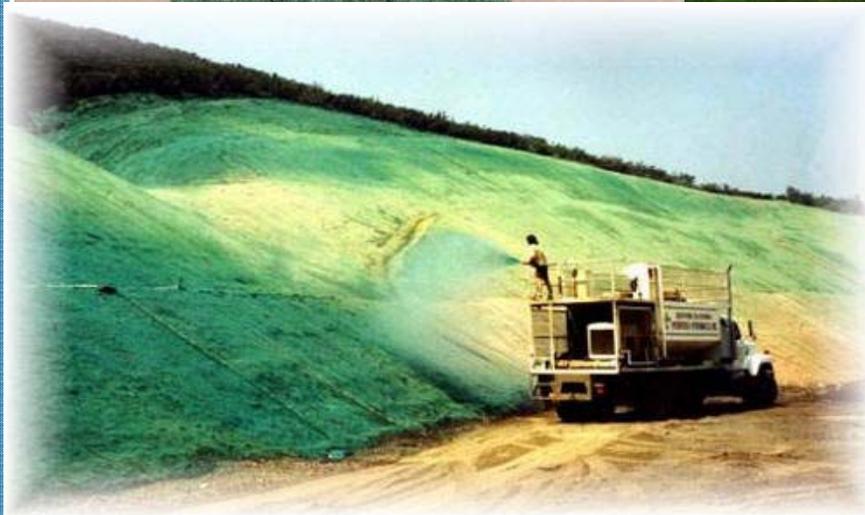
Fuel Source

- Agricultural residues can be made into a fuel source for residential and industrial applications.



Soil & Turf Products

- Agricultural residues can be made into products for erosion control & grass seed establishment.



Composites

- Agricultural residues can be used as raw materials for various composite materials.



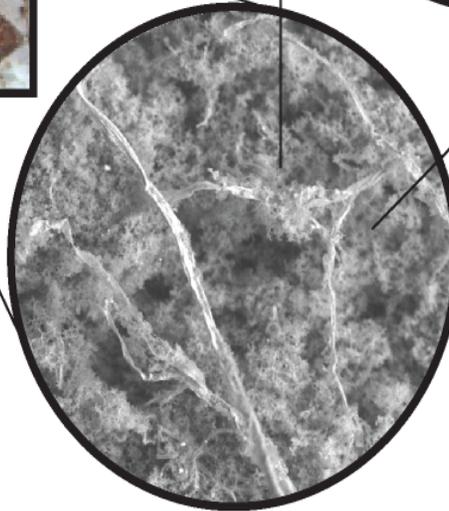
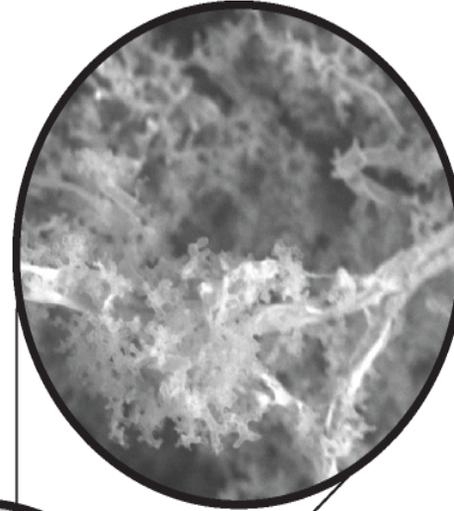
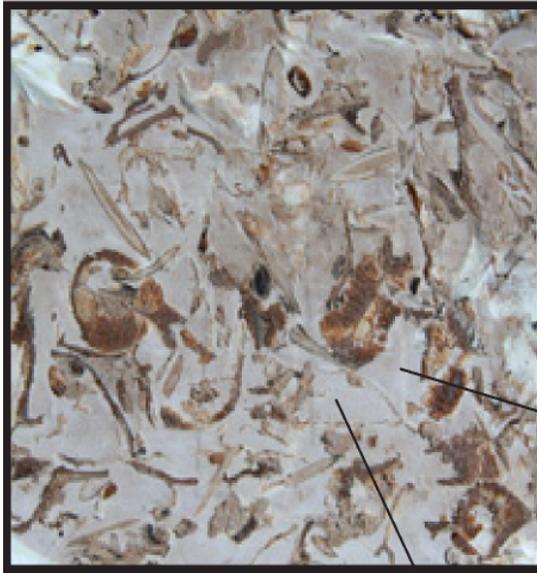




Primary Substrate - Ag. Biomass

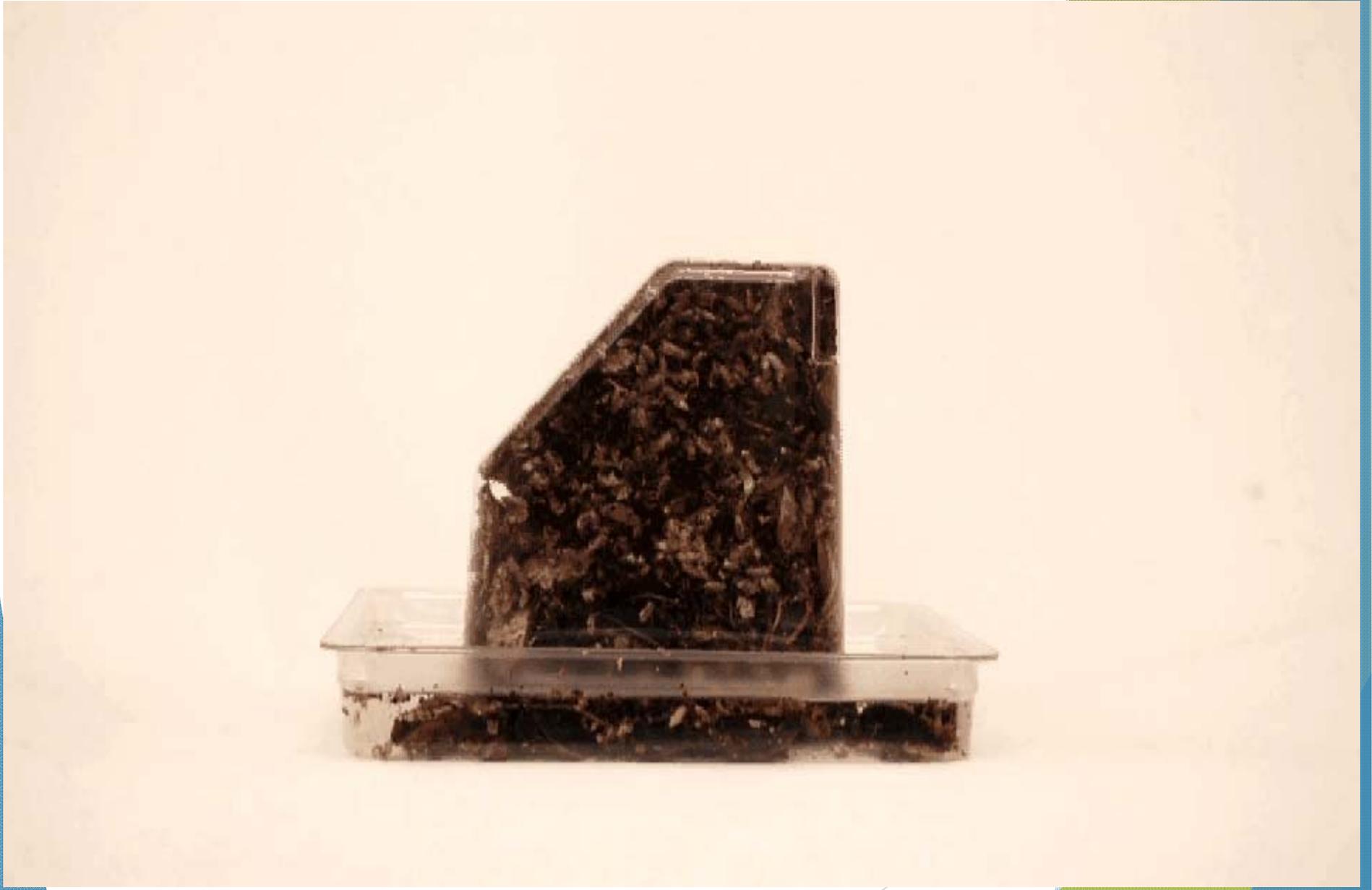


The Fungal Mycelium

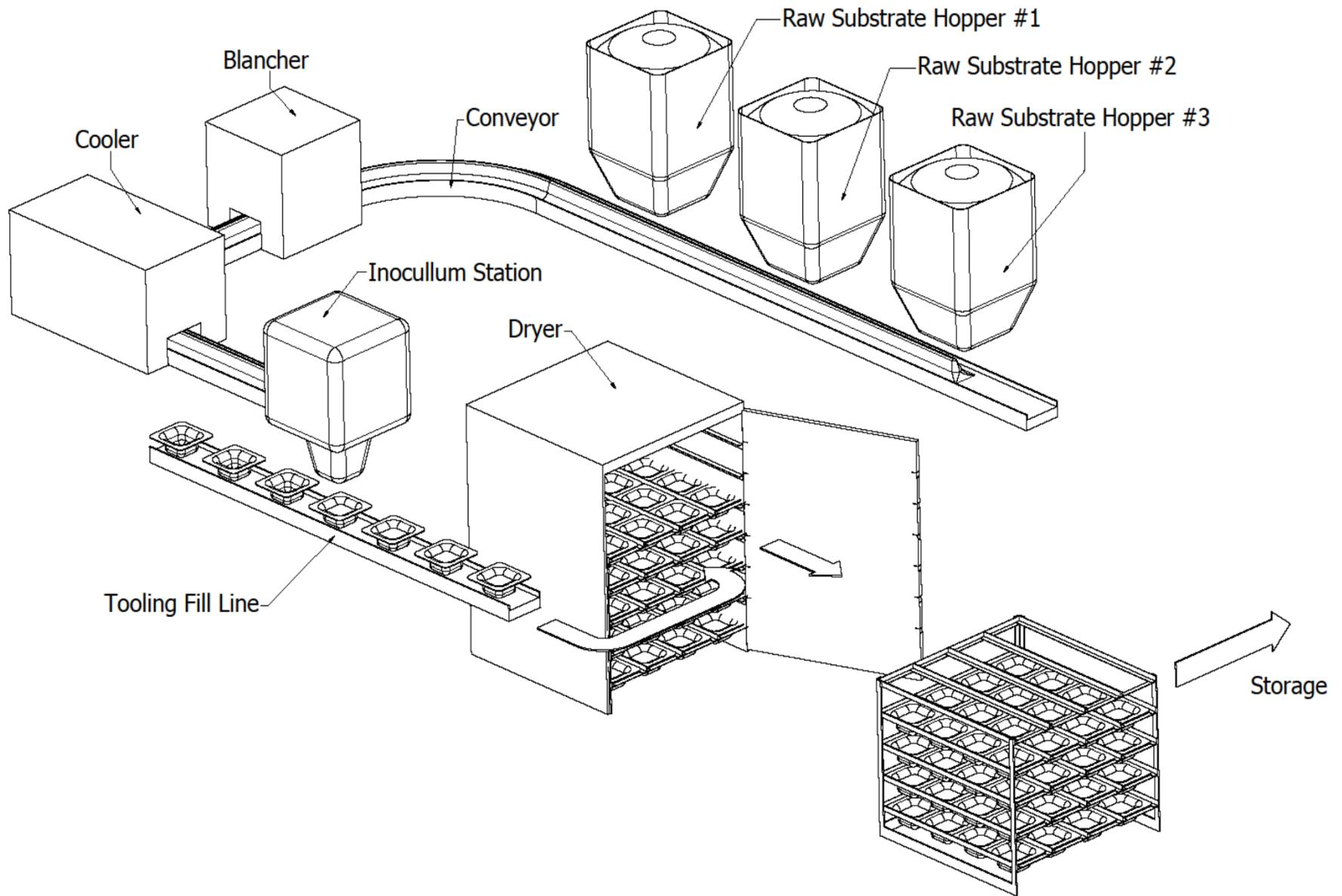


Fungal cell wall is a chitinous polymer

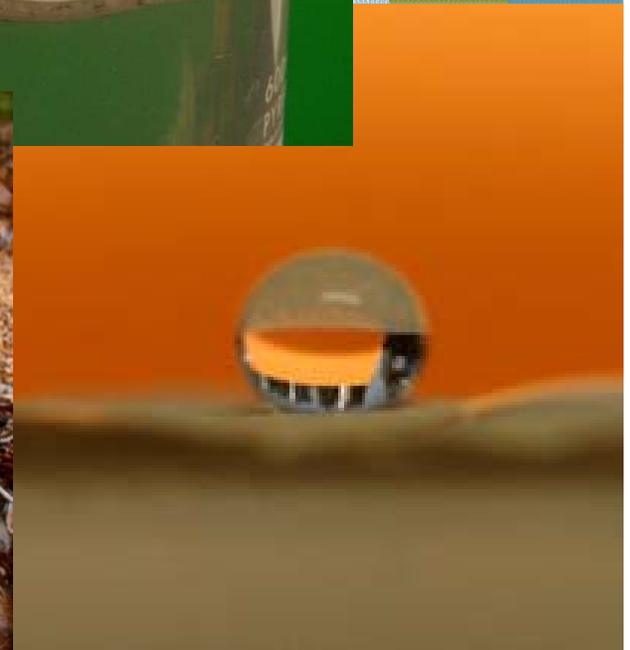
- water insoluble
- dimitic hyphae
- grown matrix





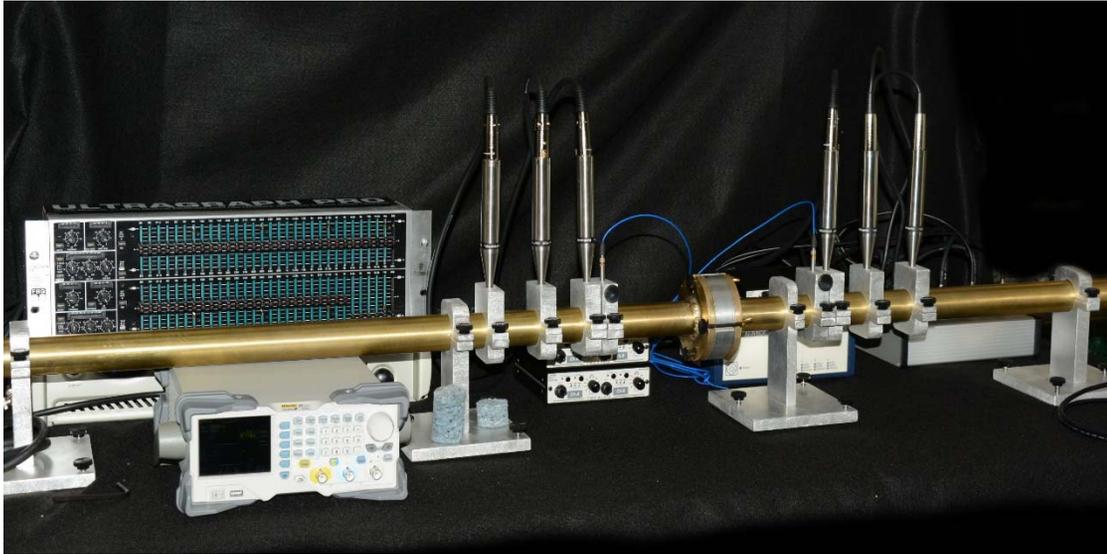


Benefits of Mycelium Composite



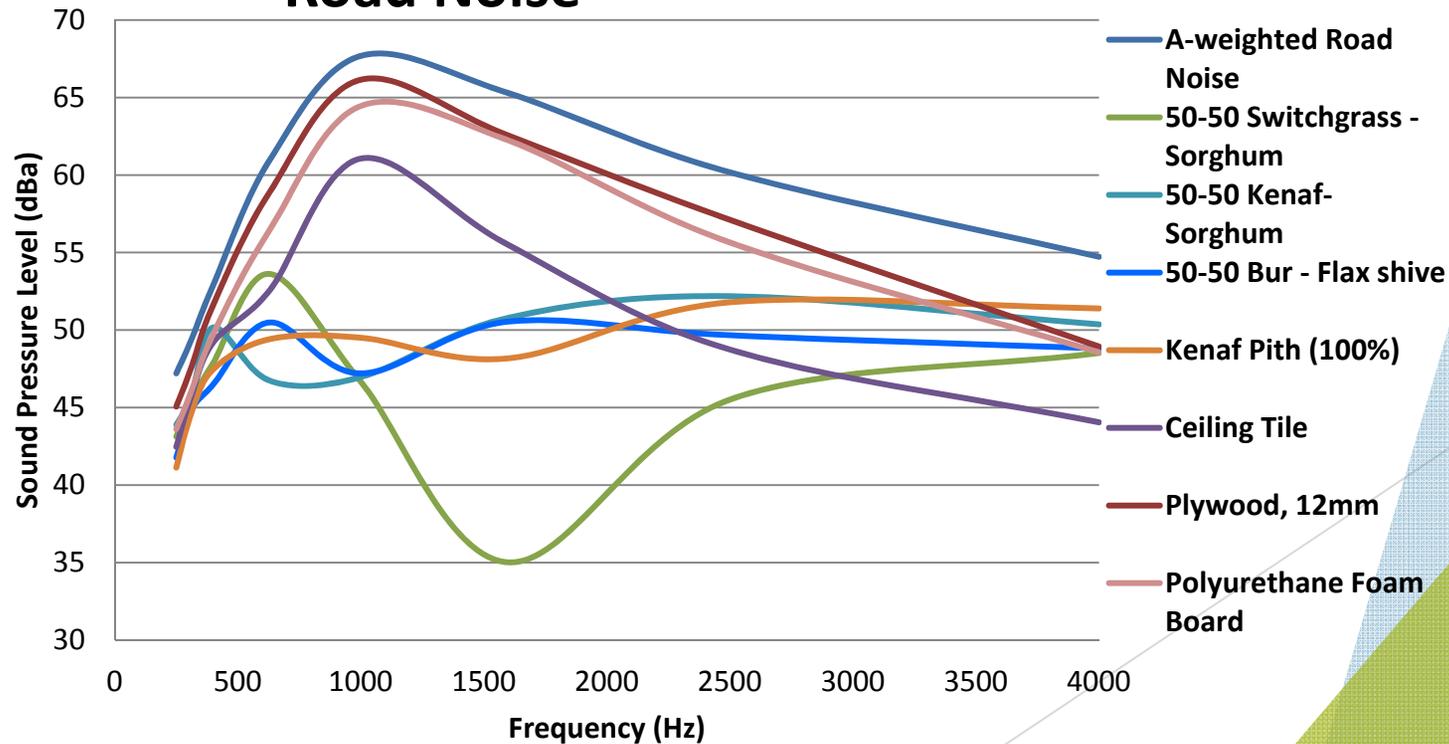
Reference Sound Levels

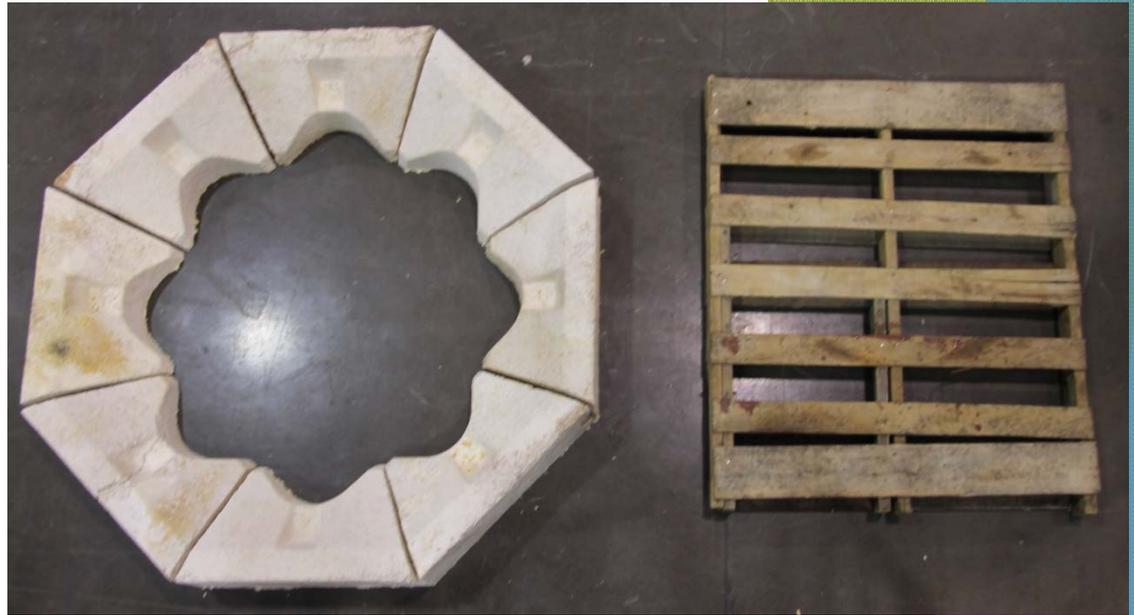
- ▶ Threshold of hearing - 0 dB
- ▶ Threshold of pain - 120 dB
- ▶ Rustling leaves - 10 dB
- ▶ Mosquito buzzing - 40 dB
- ▶ Normal conversation - 50 dB
- ▶ Busy traffic @ 10m- 80 to 90 dB
- ▶ Jack hammer @ 1m - 100 dB



Pelletier, M.G., et al. 2013. An evaluation study of mycelium based acoustic absorbers grown on agricultural by-product substrates. *Industrial Crops and Products*. 51, 480-485.

Road Noise





Biomedical Application?



GROWN, NOT GLUED
Mycro Board



- Rapidly Renewable
- Bio-based
- Tree-Free
- No Formaldehyde or VOCs
- High Screw-hold Strength
- Compostable

Flat Mycro Board

Mycro Board combines the benefits of honeycomb and particleboard into one more functional product. This core material can be produced at several densities and is strong enough to hold fasteners at any point, with superior strength to weight ratios compared to MDF. Mycro Board can be grown into solid sheetrock, entirely avoiding glue. And because it's grown with agricultural waste and without synthetic resins, Mycro Board is healthy for people, and better for our planet.



Molded Shapes

Not only is Mycro Board healthier and lighter than MDF, it can also be molded into shapes. This means your product and process designs can break free of the confines of a rectangle without generating the dust and waste of milling with CNC routers. This approach builds on the same technology that powers our "push-room" packaging platform, and gives strong, durable and natural materials in almost any shape.



Performance Specifications

Metric	Standard	Ecovative
Thickness/Depth	ASTM D1037, E1-304	0.01-1/8"
Density	ASTM D305, E1-325	18-160 lb/ft ³
Flexure of 2" depth	ASTM D2554, E11-810	500 lbs
Flexure Strength	ASTM D2554, E11-810	500 lbs
Sound Att. (1/2" depth)	ASTM D1037	100 dB
Core Shift	AS 14045, N-079	0.5" or less
Fire Res. (1/2" depth)	AS 14184	Class A
Formaldehyde Emission	AS 14133-3	0.01-0.02 ppm
	CARB Phase II	< 0.04 µg/m ³



Innovative plant fungi to grow revolutionary materials and products. These new materials are reusable. Mycelium Materials are high performance and cost effective. At the intersection of ecology and innovation, we're producing materials for a sustainable future.

Ecovative products are based on mycelium cultivated by Ecovative. These results may vary as materials are further developed. Ecovative is a registered trademark of Ecovative. Mycelium Materials is a registered trademark of Ecovative. Designated trademarks and services are used herein without intent to infringe. © 2014 Ecovative. All rights reserved.



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SAVOR® GUEST SEATING



Gunlocke®

Other...

- Interior décor...

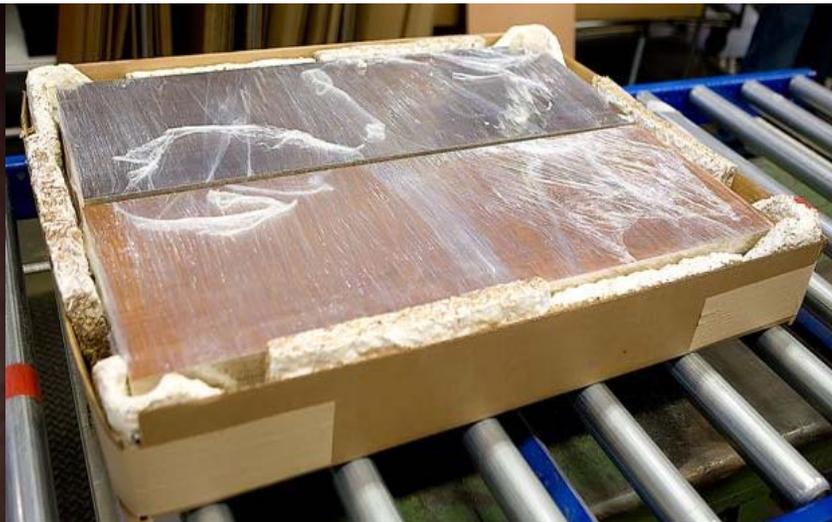


Takeaway

- ▶ Look at both the whole and the individual components
- ▶ Blends can result in better performance since one substrate can make up for the short-coming of another
- ▶ Observe the world around you for solutions (bioinspiration or biomimicry)
- ▶ Don't be afraid to think beyond the traditional. New uses, new ways of looking at raw materials and applications.



QUESTIONS?



Thanks