

Cotton's Biotech Future for Public Sector Scientists



Cotton's Biotech Present

- Adoption of biotech cotton is huge -
81% of global cotton planting in < 20 years
- Hundreds of trait types being tested
 - fiber quality, oil quality, stress tolerance, salt tolerance, Cry and non-Cry proteins insect tolerance, fungal & viral tolerance, herbicide tolerance,
- But only two trait classes commercialized
 - Cry proteins for insects (Cry1A Cry2A Cry1F)
 - Tolerance to broad spectrum foliar herbicides
 - bromoxinil glyphosate glufosinate

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Near Term Biotech Challenges

- Regulatory not getting faster, nor cheaper
 - still regulated as a novel threat
- Biotech trait Intellectual Property not getting simpler
 - highly litigious space
 - many patents required
 - many claims overlapping
 - substantial uncertainty
 - cross licensing essential

Near Term Biotech Challenges

- Fewer trait providers of cotton planting seed
 - DuPont and Syngenta received approval for their cotton traits (AHAS & VIP) but did not commercialize
 - Globally, Monsanto, Dow and Bayer provide all of the cotton traits
- Cotton planting seed sales capped
 - US and Australia's producers of 20% of global cotton bales pay >80% global biotech trait fees
 - Global hybrid corn seed sales is ~250 million acres compared with US & Australian cotton of 12 million acres

Near Term Biotech Challenges

- Most of the world's cotton is grown in developing countries
- Unlikely that Pakistan, China, and Africa will strengthen their enforcement of Intellectual Property for seed
- Likely that India could loosen their effective Intellectual Property protection as machine harvesting dictates movement from hybrids to varieties

Near Term Biotech Challenges

- Detection of Low Level Presence continues to be more robust, while seed purity methods are hitting the “biological wall” of field seed production
- Global cotton production relies on 1 highly efficacious insecticidal gene, Cry1Ac, that is increasingly threatened by resistance as it use expands into corn, soybeans, sugarcane, eggplant, rice

Cause for future optimism

- Enabling technology patents do expire! The snails pace of deregulation may allow new traits providers
- Generic traits may become a reality in cotton. Since fiber & oil is generally not a biotech regulatory concern, and 99% of our cottonseed and meal stays in North America, we are less exposed to Asian regulatory restrictions than corn and soybeans

Cause for future optimism

- Science is feeding novel biotech ideas at a rapid pace
 - RNAi pest control strategies
 - mRNAs for plant growth
 - Ionomics for improved fertilizer efficiency
 - metabolic engineering of novel pathways
- Demand for higher quality food exploding (nutritious, more protein, improved flavor)

Cause for future optimism

- “non-biotech” opportunities expanding
 - Native traits
 - Introgression of exotic germplasm
 - Marker Assisted Breeding
- Genome editing will open novel FTO & traits
 - Mutagenesis,
 - Zinc finger nucleases
 - Meganucleases
 - Talen and Cas9
- Genome editing may fall outside of current biotech regulatory restrictions

Cotton has always let the way!

- Bt-cotton is the poster child for biotechnology and opened up doors to biotech crops in Mexico, South Africa, Burkina Faso, China, India, Pakistan
- Maybe a humanitarian use of Dr. Rathore's Ultra Low Gossypol Cottonseed can open up doors in biotech consumer acceptance and demonstrate a lower cost path to market



Cotton's Biotech Future for Public Sector Scientist

- Huge benefits, Huge challenges & Huge Optimism
- So, what is the role of public scientists in cotton biotechnology?
 - Training new scientists?
 - Evaluating new products?
 - Developing management guidelines?
 - Creating new genetic resources and new variety improvement tools?
 - Use biotechnology as a tool to advance basic plant knowledge in critical areas?
 - Building proof-of-principle novel traits where industry is reluctant to invest?

Thank You

