The ICAC Recorder

Cotton Vision 2030

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ICAC Researcher of the Year 2017

Dr. Stelly is a Professor in the Department of Soil & Crop Sciences at Texas A&M University and Texas A&M AgriLife Research. Dr. Stelly is a world-renowned geneticist and cotton breeder. He has more than 40 years of breeding experiences with diploid and polyploid crops such as potato, tomato, soybean, maize, conifers, sorghum and cotton. His research also includes germplasm introgression, reproductive biology and cytology, cytogenetics, genetics and genomics. Dr. Stelly served as Chair of the International Cotton Genome Initiative, is a former President of the National Association of Plant Breeders (NAPB), an external reviewer of the USDA's Plant Genetic Resources, Genomics and Genetic Improvement program, and a member of both the International Organizing Committee for WCRC-6 and the National Academy of Sciences GE Crops Committee. He has twice received the Cotton Genetic Research Award and recently became a Fellow of the Crop Science Society of America. He is the recipient of the 2018 Cotton Biotechnology Award at the Plant and Animal Genome Conference held in San Diego, California. Dr. Stelly is a Fellow of the American Association for the Advancement of Science awardee and received the Lifetime Achievement Award from the University of Agricultural Sciences in Dharwad, India.

The Three Big Challenges for Cotton Sector in the Next Decade

1. Elevate preferences for cotton-rich textile products that benefit the consumer and society, including:

   Cotton vs. petroleum-based and other synthetic alternatives

   - Comfort; 'breathability'; better hygiene
   - Renewable unlike fossil-fuel-based fibres; cotton captures rather than releases carbon
   - Helps millions of growers rather than executives at just a few chemical companies
   - Reduces ocean and fresh water-way pollution by virtually non-degradable synthetic textile fibres
   - Sustainability improvements

1. Economic yield to producers
   - Cost-effective seed options
   - Maximised differential between cost inputs to revenue from products, with options for different levels of production investment and detailed oversight
   - Reliability of yield, quality (fibre & seed) and the ability to market products

1. Heritable improvements are among the most cost-effective means of crop improvement because they are easy to distribute widely and largely accrue across time. Among the focus areas that seem likely to lead to novel benefits:
   - Root system improvement (needs major focus)
   - Genetic solutions that enable producers to use fewer and safer chemical protectants against pests, pathogens and weeds
   - Fibre length, quality features and uniformity
   - Seed and oil quality factors as oilseed and animal feed as well as potential human foodstuffs

Production Technologies to Break Yield Barriers

- Adapt, adopt and adeptly use integrated satellite, UAS and ground surveillance systems to aid production-related GPS-guided decisions (irrigation; pests; pathogens; weeds; growth stages; field variability/amendment)
- Solar-powered GPS robot systems for worker-limited production areas, to help with field monitoring and weeding, especially at early-growth stages. This could become all the more important if health-based or other concerns severely constrain the availability of migrant workers, or as weeds adapt to herbicides
- Smartphones to deliver relevant production and marketing information and consultation to remote small holder farmers in countries with a poor or uneven educational infrastructure

Promising Recent Advances in the Science Of Genomics, Genetics and Plant Breeding

- Rapidly increasing public genomic resources (types and volumes of data and tools)
- 'Tools' to use resources will continue to evolve quickly
- Cost of using genomics tools will continue to fall but seem likely to be more than offset for a while by a global economic downturn due to COVID-19
- Genome selection
- Greater recognition, new tools and methods for using epigenetics
- Progress in manipulation of homologous recombination
- (Epi)Genetic engineering — transformation and editing
- Roles of dispensomes in fungal diseases? Could this lead to improved control over certain pathogens? Or new fungi as pest control agents?

Contribution of Genomics Research for Yield Enhancement and Fibre Quality Improvement

- I feel like there is the need for a lot of exploratory research in this area.
- Can we achieve scientifically designed approaches to fibre enhancement by better defining the differential genetic amplification, epigenetic modifications, transcription, RNA processing and translation in fibre cells?
- Can cisgenic and allied types of gene replacement or augmentation approaches be helpful?
- To what extent are epigenetic alterations heritably affecting key traits?
- Can we characterise and understand the relative importance of transcription factors in variation of economic traits and their inter-relationships?

How Can Cotton Combat Climate Change?

- Shift production areas and seasons or vary planting areas and time
- Genetically improve resilience
- Enhance relevant production practices

Novel Technologies to Fight Insect Pests, Weeds and Diseases

- Gene drives
- Confusing pheromones
- Altering cotton's signature odours

Cotton Transgenic Technologies and the Way Forward

- Public researchers need to help society by delivering traits that help with economic yield and sustainability
- Need more methods and 'tools' that are free from IP protection
- Continue improving the speed of transformation and editing

Role of Robotics, Electronics and Communication Technologies for Cotton

- Production decisions using integrated sensing platforms (integrated satellite, UAS & ground surveillance)
- Improved methods for characterising root systems and genetic effects on them, as well as the use of model systems to expedite cotton root system knowledge and improvements, including scalable root-growth monitoring systems, genomics; ground-penetrating radar methods.

Any Other Exciting Novel Innovations and Game-Changing Technologies

- Epigenetics — We need to fully explore the degrees to which epigenetics affect traits of importance and how we might leverage that control to enhance cotton
- Gene editing (DNA sequence and epigenetic status)
- Possibly gene-drive systems — if they are effective and safe to deploy for controlling serious sexually reproducing pests

Advice to Young Cotton Scientists: How to Gear Up for the Challenges of 2030

- Stay alert and keep a broad view of science. It will change a lot in 10 years, likely including one or several major fundamental scientific and technological innovations that can affect your work
- Promote international scientific cooperation to improve cotton globally, strengthen its sustainability characteristics and bolster its baseline competitiveness in the market
- Use new technologies to enhance communication, interaction and cooperation with others. These will help you spawn new ideas.