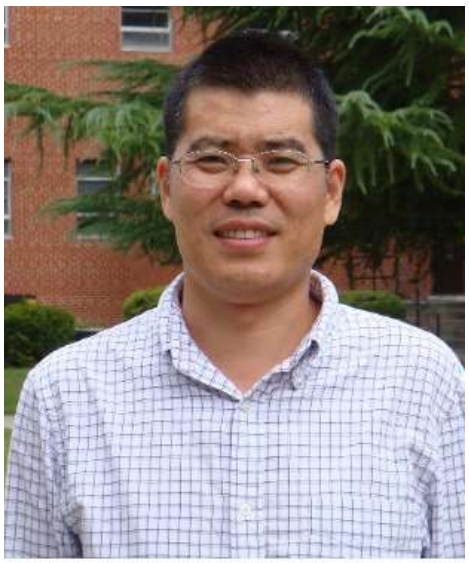
The ICAC Recorder

Cotton Vision 2030

Baohong Zhang, USA

ICAC Researcher of the Year 2018



Dr. Baohong Zhang is currently working as a distinguished professor at East Carolina University (ECU, US). Dr. Zhang graduated from China Agricultural University. After he received his Bachelor's degree, he worked on cotton biotechnology at the Chinese Academy of Agricultural Sciences and received his PhD from Texas Tech University in 2006. Dr. Zhang has authored more than 200 publications with more than 13,000 citations; many of them are listed as highly cited papers by the Web of Sciences (his h-index is 53). Dr. Zhang frequently reviewed manuscripts for many international journals, including Nature and Nature Biotechnology. He also served as an Associate Editor or Guest Editor for seven journals, including Scientific Reports and Plant Biotechnology Journal. He has reviewed proposals for more than 40 funding agents, including NSF, US DoE, US USDA, and NSFC. Dr. Zhang was elected to the Fellow of the American Association for the Advancement of Science (AAAS) in 2018. He won the 2018 ICAC Researcher of the Year 2018 and the following year he won the THCAS Distinguished Professorship and the Highly Cited Scholar awards. Recently, he won the Lifetime Research Achievement Award, the top honour for ECU faculty. He also has won the Cotton Biotechnology Award.

The Three Big Challenges for the Cotton Sector in the Next Decade

There are many challenges for the cotton sector in the next decade; I think the three biggest will be:

1. How to produce enough fibre to meet the consumption demand.
   - World cotton consumption will increase smoothly but the increase of cotton production is much slower and could even decrease as more famers switch to other crops.
   - Pests and diseases may be a big problem cotton will have to face. Although transgenic Bt cotton has solved a lot of problems for controlling certain pests, those pests may generate resistance to Bt cotton and other pests could become the dominant pest in cotton field. Pathogens may cause new diseases in the cotton field.
   - Cotton will face more competitive pressure from old and new materials, including polyester.
2. Novel production technologies that can break yield barriers

   Transgenic and genome-editing technologies will become major tools for cotton-precise breeding to increasing cotton yield, quality and resistance to various environmental stresses, including newly emerging pests and pathogens. The application of artificial intelligence (AI) on cotton production and the market may also break the yield barriers for cotton.
3. Promising recent advances in the science of genomics, genetics and plant breeding

   The recently completed and ongoing cotton genome sequencing research projects open a new era for studying gene function in cotton as well as precise cotton breeding. In the next 10 years, the majority of genetic studies in cotton will switch to gene functioning to enhance our knowledge for precise breeding in cotton.

Contribution of Genomics Research for Yield Enhancement and Fibre Quality Improvement

In the next 10 years, traditional cotton breeding will be integrated with modern molecular breeding, including transgenic breeding and genome-editing-based breeding. Genomics research will contribute much more than ever on cotton improvement. As more cotton genomes are sequenced, the genes and their involvement in gene networks controlling cotton yield and quality as well as responses to biotic and abiotic stresses are being identified and characterised. These genes and/or gene networks will soon become targets for transgenic and genome editing for breeding new cotton cultivars for yield enhancement and fibre quality improvement.

How Can Cotton Combat Climate Change?

Climate change is a global issue that threatens all plant species and our entire society. To face climate change, cotton breeding may play more important roles, including new cotton cultivars with tolerance to high temperature (for summer), low temperature (for early planting), and drought (for water saving).

Novel Technologies to Fight Insect Pests, Weeds and Diseases

Transgenics and genome editing will play a huge role in breeding new cotton cultivars that can fight pests, weeds and disease. Artificial intelligence (AI) technology will be used to monitor and manage pests, weeds and diseases.

Cotton Transgenic Technologies and the Way Forward

Cotton transgenic technologies, including advanced genome editing technologies, will play an increasingly larger role in cotton breeding, including improving cotton yield fibre quality as well as fighting environmental stresses.

However, there are a few issues that need to be addressed:

- A novel strategy for obtaining transgenic and genome editing plants is needed to provide a wider range of cotton genotypes; this may be achieved by improving current transformation methods or developing completely new approaches for obtaining transgenic plants.
- New genes for cotton yield, quality and tolerance; this could be discovered in cotton's own genome (wild species) or from other resources.
- Diversity of transgenes, which could be an area of emphasis for scientists. When quickly adopting transgenic cotton, the diversity of cotton cultivars could be decreased, which would generate new risks for cotton production systems.

Role of Robotics, Electronics and Communication Technologies for Cotton

It is certain that robotics, electronics and communications technologies will have more applications in cotton production, harvesting, management and marketing.

Any Other Exciting Novel Innovations and Game-Changing Technologies

Artificial intelligence (AI) and digital agriculture will play a greater role in cotton production and markets.

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

The next 10 years will be a promising and challenging decade for cotton scientists, with rapidly developing technologies, so young cotton scientists need to adapt quickly — and even develop their own new technologies to use for cotton research and development. Over the next 10 years, interdisciplinary and international collaboration is crucially important, so young scientists need to master the knowledge and principles of their own field but also that of closely-related fields, especially those in different countries.