The ICAC Recorder

Editorial

This volume of the ICAC RECORDER is a special issue focussing on 'Cotton Breeding and Genomics'. Plant breeding plays a key role in crop improvement. In modern times, genetics, genomics and molecular biology dominate agricultural research, often overriding the science of plant breeding. In a private conversation I had during a poster session at the recent Beltwide conference in Austin, Texas, a PhD student remarked to me that plant breeding was no longer 'sexy' and it was far less attractive than genomics and molecular sciences. It was interesting to hear him tell me confidently that 'plant breeding was a supporting science as it supports the science of genomics' and that genomics was the main gateway to improving agriculture — a generational change indeed. I always thought that it was the other way around where genetics, genomics and molecular sciences assisted and supported plant breeding, which played a pivotal role in crop improvement.

Each of these branches of cotton science has its own importance. Though plant breeding is widely believed to have contributed more substantially to crop improvement than any other branch of agricultural sciences, young researchers — for reasons best known to them — appear to be oriented more towards genomics and molecular biology to enhance fibre quality and increase yields. Nevertheless, plant breeding continues to be acknowledged for its critical role in crop improvement. At the ICAC Plenary Meeting in India in 2015, Dr Greg Constable, the renowned Australian cotton agronomist and plant breeder, pointed out that in Australia, plant breeding was responsible for 48% of the large yield gains of over 1,300 kg/ha of lint over a 30-year period; about 24% of the gain was due to modern crop management; and about 28% of the yield improvement was new cultivars responding more to modern management, thus attributing 76% of yield gains to the role played by cultivars. Interestingly, not once did he mention that transgenic technology may have played a role in yield enhancement in Australia. Dr Constable also showed that the theoretical yield was about 5,034 kg/ha of lint, while the best irrigated crops in Australia reached 3,500 kg/ha lint in 2015. Commendably, the Australian plant breeders not only succeeded in developing cultivars for high yields but also achieved high-quality fibre simultaneously, something that many plant breeders in other parts of the world think is not easy to achieve. In one of this issue's articles, Dr Shreekant Patil expresses his confidence that it is possible to develop cotton cultivars for high yields with high fibre quality through innovative approaches of plant breeding based on the principles of quantitative genetics.

Agricultural sciences are very complex and so are the concepts related to yield enhancement. High yields and high fibre quality are a function of many factors that include climate, water, nutrients, management and cultivars. A cultivar can contribute to high yields if it has the genetic capability to perform well under both ideal and challenging environments. Such cultivars are generally developed by plant breeders who have a sound background in agronomy, physiology and plant protection. What kind of plant-type should breeders develop for high yields? Big plants or small plants? Should they have100 bolls per plant or 10 bolls per plant? Short duration or long duration? Big seeded or small seeded? Single picking or multiple picking?

These questions solicit different responses from different countries. Plant breeders from India and Africa believe that to get high yields, it is important to have more bolls per plant, big-seeded cultivars, large-statured plants, long duration and multiple pickings. Plant breeders from Australia, China, Brazil, Turkey and USA, on the other hand, have strived over the past 30 to 40 years to achieve exactly the opposite of what the Indian and African plant breeders aim to develop. They obtained high yields and high-quality fibre with short-statured plants, fewer (10-15) bolls per plant, small-seeded, short-season cultivars and fewer pickings — and they also achieved a high harvest index in the process. Having diametrically opposed ideas seeking to achieve the same goal, high yields, is indeed perplexing. Nevertheless, the fact remains that with concepts of big plants, big seeds, more bolls per plant, long-season and multiple pickings, India and Africa aren't succeeding and are stuck with low annual national average yields of less than 500 kg lint per hectare whereas Australia, China, Turkey, Brazil harvest more than 1500 kg lint per hectare.

Australia's successful cotton journey is inspiring the world. It remains to be seen if cotton scientists of Africa and India are willing to be inspired by the Australian cotton success story. On the sidelines of the recent ICAC Plenary Meeting in Brisbane, I was part of an international group that visited cotton fields in Australia. The effects of drought were telling on the fields and the plants looked smaller than usual. '*Beyond doubt, this crop will give low yields*' declared a

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visitor from India. A cotton scientist from Africa seemed very unhappy with the 50-days old short-statured plants. He explained animatedly to the Australian farmer that the crop in his country would have reached waist height at 50 days and wouldn't be at half-knee height, as it was in Australia. He asserted that something was not right with the crop in Australia. It was interesting to hear the cool, casual response of the Australian farmer: '*Well, I usually get 11 to 12 bales from this kind of a crop and am confident of the same this year, too*'. The farmer was expecting 11 to 12 Australian bales (227 Kg per bale), which would translate to 2497 to 2724 kg lint per hectare — something that neither the African scientist nor the Indian delegate could dream of achieving in their countries. I feel that cotton scientists can greatly benefit by understanding the Australian approaches and sustainable strategies of yield enhancement through plant breeding and scientific crop management. There is also a need to introspect if the current plant breeding strategies in India and Africa would succeed in breaking yield stagnation or if a paradigm shift in plant breeding objectives would be necessary.

This issue of the ICAC RECORDER has articles that discuss plant breeding strategies to enhance yields. It has articles authored by Dr. Shreekant Patil, an eminent cotton geneticist and a renowned Indian cotton breeder; Dr. Dharminder Pathak, an acknowledged cotton breeder; and Prof. Yuolu Yuan, a cotton genomics expert from China. The three articles describe concepts, ideas and innovations in cotton breeding, genetics, genomics and molecular sciences in the context of the recent progress made in cotton cultivar improvement, which I earnestly believe will be very useful for cotton researchers to formulate projects for high yields and premium fibre quality. I am thankful to Dr H. B. Santosh, the young talented plant breeder of ICAR-Central Institute for Cotton Research, Nagpur India for sharing his critical insights on the articles.

-Keshav R Kranthi

Dr. JOHN YU -COTTON RESEARCHER OF THE YEAR 2019

Dr John Yu has been working with the USDA-ARS since 1995. He earned his PhD in plant genomics and molecular genetics at Cornell University. He demonstrated outstanding dedication, with 36 years of professional experience, and received significant recognition as an international authority in cotton genomics for developing genetic resources that are currently being used by scientists worldwide. He made major contributions on cotton genomics and germplasm, including genome mapping and sequencing, characterisation of gene pools, and identification of QTLs for molecular breeding.

Dr Yu developed the world's first integrated genetic, physical and transcript maps of cultivated tetraploid cotton chromosomes with large insert DNA clones, molecular markers, and EST genes; and high-density cotton genetic maps of portable SSR and SNP markers. He has freely filled numerous requests from the global cotton research community for genomic resources and information. Dr Yu has received several national and international awards and published more than 100 peer-reviewed papers, which have 8,945 citations. Dr Yu has also delivered more than 60 talks/seminars to the global scientific community.

Dr Yu demonstrated dynamic, outstanding organisational capacity in a leadership role to benefit the global cotton community. This includes his election in 2005 and re-election in 2015 by the global cotton community as Chairman of the International Cotton Genome Initiative (ICGI), the first international organisation to facilitate global collaborative research work on cotton genomics and genetics.

Dr Yu led international efforts to develop and release genome sequences for G. arboreum, G. raimondii, and G. hirsutum, among other cotton species. The research opens a new paradigm in cotton genomics that revolutionises genetic improvement of cotton plants through better exploitation of genetic variation otherwise buried in Gossypium germplasm. His discovery of gene-rich islands and sub-genomic roles in upland cotton provides critical information for genetic applications. His development of new concepts and methodologies for standardising characterisation of Gossypium germplasm makes it possible for cotton researchers worldwide to collaborate, relate and utilise genetic diversity data among cotton germplasm collections.