INTERNATIONAL COTTON
ADVISORY COMMITTEE

1629 K Street NW, Suite 702,
Washington, DC 20006, USA

78th Plenary Meeting – Brisbane (Australia)

MINUTES

Seventh Open Session

Breeding and producing high yielding and high-quality cotton planting seed: what's required

1:00-2:30 pm, Wednesday 4 December 2019
Chair: Ms. Kathryn Adams, Director, Cotton Research & Development Corporation, Australia

Ms. Adams opened the session.

Dr. Warwick Stiller, Research Group Leader, Cotton Breeding, CSIRO, Australia presented Learnings from a successful breeding program: challenges, priorities and realities.

An overview of the CSIRO Breeding Program was presented. The objective of the cotton breeding program is to develop new Australian cotton cultivars with the goal of increased yield, fibre quality preferred by international spinners, resistance to all important disease. This is achieved through the integration of traditional breeding and modern tools together with the understanding of market requirements.

The success of the CSIRO Cotton Breeding program is dependent upon large populations and collection of accurate multisite and multiyear data. High Australia yields compared across other countries has come with much work for development and continued maintenance. Much of the gain in higher yields come from new cultivars, with additional gains from crop management, with the remaining level of gains coming from cultivar management. Over time, more and more disease resistance has been incorporated into the varieties produced. The current focus is on yield and quality improvement under high input, well managed farming systems, improved pest resistance and developing varieties with new GM traits.

Stages of breeding programs were introduced on primary, secondary and tertiary stages with increasing focus and target from general to specific development. At the tertiary level the primary focus is on the overall package of yield, fibre quality and disease resistance. Most of the work of the program is at the tertiary level relying on the primary and secondary level work that has been development in house.

Through the program, they have learned that breeding is a powerful tool, but it is critical to understand the industry, how technology is advanced and constraints to production as some of these issues need to be addressed outside of breeding so that breeding can be used to make the needed further improvements. Breeding is not a solution for issues that need to be addressed at the system level.

As an example, in some newer regional in tropical Australia, the challenges in the system are outside of cultivar issues. Issues on management practices, use of regulators, deciding a planting window, etc need to be addressed first so that the target that the needed cultivar needs to be developed for can be used correctly and efficiently. Breeding is expensive and long-term where the return of investment is often better and quicker through changes in management. Constraints and goals are needed for breeding with difficult traits. The breeding approach needs to be done with realistic goals of what can be achieved.

New cultivars can address production constraints and improve yield and quality However, this must be targeted for each production region – there are no shortcuts New cultivars will not solve some major production issues – these need to be addressed by changes in soil and crop management. New technology is powerful, but must be supported by research, stewardship, production protocols and quality assurance

The delegate from Argentina asked about the interaction between germplasm and environment. Is there a strategy to select for specific characteristics? There is some long-term work in developing models – such as climatic models – to address this, but there is no short-term selection strategy. A second question was asked about increasing the variability of variety. Variability is essential for selection, however at the tertiary stage, too much variability for selection is not helpful, good or useful. Work to increase variability is long and time consuming and would need a long-term approach and may not produce the desired results.

The delegate from Mali asked about disease resistance and what has been done to eradicate deadly disease. Bacterial blight was addressed through breeding by introducing genetic resistance almost 30 years ago. Other diseases need a range of management strategies in conjunction with breeding. Through breeding there has been some success that work with improved crop management practices.

Mr. Brett Ross, Quality, Research & International Lead, Cotton Seed Distributors, Australia presented on Producing high quality planting seed: the Australia perspective stressing that seed production is highly system specific.

Cotton Seed Distributors is a company limited by guarantee in Australia, founded by growers in 1967 by members not shareholders. Together with CSIRO they have released over 100 cotton varieties released to the Australia market. Bayer has the exclusive world-wide rights to market the current CSIRO cotton germplasm outside of Australia. Currently over 99% of cotton varieties sold in Australia are GMO with the majority containing B3F traits under license from Bayer.

Seed production - All seed crops are grown to internationally accepted OECD Seed Scheme standards. Crop inspection results are audited annually. All early generation seed increase crops are grown under strict control on CSD farms. Seed increase may include regulated (OGTR) and stewarded (Bayer) material. Seed crops are grown under contract where potential growers submit and expression of interest to grow. Proposed fields are inspected prior to selection. All cultural operations are inspected and monitored throughout the season. There is an intense quality assurance system in place from pre-planting to harvest. The ginning process is strictly regulated monitoring and managing moisture content using a Vuma unit. Seed receivals are tested for cutting test, free fatty acid, moisture content, residual lint percentage, germination, transgenic purity, mechanical damage and seed recovery.

Seed processing – Fuzzy seed is delinted in high capacity in a HCl gas delinting plant. Delinted seed is screen cleaned and gravity graded before bagging.

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Seed testing – Seed is tested to international accepted test methods and main germination tests are cyclic and constant. Seed quality is assessed throughout the multiplication process. Over 50 assessments are taken for each seed including testing for trait purity, germination potential, fungicide and insecticide seed treatment quality and long-term storage potential. All seed produced needs to meet various contractual standards.

Seed storage – Temperature plays an important role in storage of seed. Insects and moulds increase as temperature increases. The higher the moisture content of the seeds, the more they are adversely affected by temperature. Decreasing temperature and seed moisture is an effective means of maintaining seed quality in storage.

A question from the floor on the best label to register cotton F8 or F9. Which filial generation is better for commercial cotton? Normal selection starts at F4 stage. Generally speaking, as long as you can maintain purity standards, most would go into seed production would go into commercialisation at the F9 stage, not as a rule, but perhaps as a target.

A question from the floor on rain fed area in Australia and the politicisation of GM in Australia. In Australia, potential 500 hectares dryland and 500 hectares irrigated. How many varieties are produced each year? Of the 12 or 13 produced, there may be carryover from the previous season with 8 developed. There are three cultivars that cover more than 90% of the Australia crop.

A question from the floor on thresholds for purity. Purity is maintained at 98%. There is a stringent quality assurance program that allows they CSD to address any issues in purity early on in the process.

Dr. Bruno Bachelier, Cotton Correspondent, CIRAD, France presented on behalf of authors Mr. Jacques Lançon, Dr. Bruno Bachelier, Mr. Marc Giband & Mr. Romain Loison on Quality seed for Africa – Opportunities, challenges and perspectives

Cotton production in Africa includes 28 producing countries, covering 4.5 million hectares, producing 1.5 million tonnes of fibre and employing 3 million small-holder cotton farms that support the livelihoods of 20 million people. The production is low on a worldwide scale accounting for 4% of world total but is economically important for Africa. The crop is largely exported as unprocessed raw fibre. Cotton production represents enormous potential but currently has the lowest yields in the world.

Opportunities and challenges – Opportunities exist on three levels: structures that are in place for collective action; the skills that are available for collective action; and availability of additional skills and tools.

Amongst the structure in place there are: organization and legislation, including cottonseed registration processes and quality control; national coordination bodies, with representatives of the main stakeholders; research, often involved in the cottonseed multiplication scheme; private sector (ginning companies), often supporting cottonseed growers and farmers, organized in groups.

Amongst the skills available for collective action there exist: research often in charge of the maintenance of nucleus and breeders' seed; experienced professionals familiar with cotton, including researchers, growers, ginners, extension staff; experience with seed delinting in some countries; and genetic material locally adapted with good characteristics (GOT and fibre quality).

Amongst additional skills and tools available, there are: research staff experienced and skilled to develop multidisciplinary approaches (Crop Management Systems); experienced staff to manage breeding programs; HVI equipment available in some countries; experienced professionals with

know-how in the maintenance of major equipment (e.g. ginning), and willing to participate in breeding programs or in the improvement of cropping systems (conventional, CmiA, organic)

Challenges in two levels: access to resources (genetic diversity, research funding) and collective action (interactions between research and other stakeholders).

The challenge of access to resources include the need for genetic diversity, including resistance or tolerance to diseases and pests; research funding and inconsistent level of investments; and increased human capacity through training and recruitment. Collective action is needed through formalised partnerships between researchers and stakeholders and better regional coordination for the promotion of seed exchange and capacity building.

New breeding methods have been introduced including biotech and new breeding technologies include marker assisted selection; biotech cotton and CRISPR/Cas 9 based genome editing. Precision phenotyping allows better in-depth knowledge of the genetic material, better understanding of the genetic bases of characteristics; better understanding of GxE interactions and to feed predictive models. Participatory breeding is the decentralised breeding with farmers that can increase the breeding efficiency through a better adaptation to a diversity of cropping environments, and because of more diverse selection pressures. Cropping system models generate a better understanding of genotype x environment interactions and test performance over a wide range of environments.

A systemic approach has been undertaken to create a prototyping cropping system involving multi-disciplines and multi-actors to bring together scattered knowledge and experience from differing disciplines, experts and stakeholders. This prototype allows better understanding of a specific and complex agricultural system in order to find innovative and relevant solutions to solve problems. Multi-actor platforms have been efficient to manage a seed multiplication scheme, to design a breeding program or to evaluate new genetic material. In a multi-actor platform, experts bring their experience and knowledge, decision makers look after strategic decisions and the management of resources and facilitators create bonds between the communities of interest.

Collective action is needed. International collaboration where international companies that are investing in cotton share their experience and knowledge across national boundaries would increase efficiency and widen the benefits of the knowledge and experience. National research programs face decreased capacity at times and so by joining resources, tools and strategies, more could be achieved with neighbouring countries facing similar challenges.

In conclusion, CIRAD pleads for the creation of an African network on cottonseed. Its cotton gene bank may serve as a bridge between breeding programs in Africa and around the world. It can mobilize relevant skills and organize professional training. It can facilitate regional collaborations. CIRAD joins the international initiative launched by ICRA to promote the sharing of information on existing germplasm collections worldwide, to agree on common descriptors and to achieve a more comprehensive assessment of germplasms.