Quality seed for Africa
Opportunities, challenges and perspectives

Jacques LANÇON, Bruno BACHELIER, Marc GIBAND, Romain LOISON

CIRAD (Centre for International Cooperation in Agronomic Research for Development, France)

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Quality seed for Africa
Opportunities, challenges and perspectives

• Cotton production in Africa
• Opportunities and challenges
• Novel breeding methods
• Systemic approach
• Collective action
• Conclusion
Cotton production in Africa (source ICAC 2019)

- ~ 28 producing countries
- ~ 4.5 M ha
- > 1.5 M tons of fibre
- > 3 M small-holder cotton farms...
- ... that support > 20 M people
Cotton production in Africa (source ICAC 2019)

• Low on a worldwide scale (6 %)...

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Cotton fibre production 2017/2018 (source ICAC 2019)

Cotton production in Africa

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Cotton production in Africa (source ICAC 2019)

• Low on a worldwide scale (6 %)...

• ... but economically important for Africa

• Largely exported as unprocessed raw fibre (> 87 %)

• Quickly increasing after a sharp drop
Cotton fibre production in Africa (source ICAC 2019)

Million tons

Cotton production in Africa

Opportunities and challenges  Novel breeding methods  Systemic approach  Collective action  Conclusion
Cotton production in Africa (source ICAC 2019)

• Low on a worldwide scale (6 %)...

• ... but economically important for Africa

• Largely **exported** as unprocessed raw fibre (> 87 %)

• Quickly **increasing** after a sharp **drop**

• A huge potential but among the **lowest yields** in the world
Cotton fibre yield 2017/2018 (source ICAC 2019)

kg/ha

N. America  C. America  S. America  Europe  N. Africa  W. & C. Africa  E. & S. Africa  W. & C. Asia  E. Asia  S. Asia  Oceania

World average

806 kg/ha

399 kg/ha

249 kg/ha

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Opportunities (1/3)

STRUCTURES IN PLACE FOR COLLECTIVE ACTION

• Organization / legislation, including often 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
• Farmers, organized in groups
Opportunities (2/3)

SKILLS FOR COLLECTIVE ACTION

• Research often in charge of the maintenance of nucleus and breeders’ seed
• Lots of experienced professionals familiar with cotton, including researchers, growers, ginners, extension staff (ancient history)
• Experience with seed delinting in some countries
• Genetic material locally adapted with good characteristics (GOT and fibre quality)
Opportunities (3/3)

ADDITIONAL SKILLS AND TOOLS

• 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 (1/2)

ACCESS TO RESOURCES

• Genetic diversity needed, including resistance or tolerance to diseases (*Fusarium* wilt) or pests (Jassids)

• Research funding, and level of investment (equipment, storage facility, laboratories, human resources) to be more consistent

• Human component to be strengthened (training and recruitment)
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Challenges (2/2)

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Challenges (2/2)
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Introducing novel methods in breeding programs

BIOTECH AND NEW BREEDING TECHNOLOGIES

• Marker-assisted selection: tool with proven efficiency for qualitative traits (e.g. disease resistance)
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• Marker-assisted selection: tool with proven efficiency for qualitative traits (e.g. disease resistance)
• Biotech cotton: various scenarios: cultivated, approved, discontinued, not approved...
  ▪ Need for a serene science-based analysis of the pros and cons
  ▪ Lack of regional regulations
Introducing novel methods in breeding programs

BIOTECH AND NEW BREEDING TECHNOLOGIES

• Marker-assisted selection: tool with proven efficiency for qualitative traits (e.g. disease resistance)
• Biotech cotton: various scenarios: cultivated, approved, discontinued, not approved...
• CRISPR/Cas 9-based genome editing
  ▪ Potential for significant impact on breeding – how close to the field?
  ▪ Regulation (e.g. EU vs US approach)
  ▪ See « The ICAC Recorder » vol. 37 # 3 - Special issue: modification of gene CRISPR / cas9 in cotton
Introducing novel methods in breeding programs

PRECISION PHENOTYPING

What precision phenotyping can allow:

• Better in-depth knowledge of the genetic material
  - e.g. disease tolerance vs disease resistance
  - e.g. components of productivity

• Better understanding of the genetic bases of characters of interest

• Better understanding of the G x E interactions

• To feed predictive models
Introducing novel methods in breeding programs

LINE VALUE

• Estimated as the mean of a random sample of F3 lines derived from a cross

• Comparing the « line value » of several crosses:
  ▪ Optimizes the chances of getting genetic gains by selecting the best crosses
  ▪ Can be conducted in contrasted cropping systems (different planting dates or levels of pest control...)

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PARTICIPATORY BREEDING

Decentralized breeding with farmers can:
• Increase the breeding efficiency through a better adaptation to a diversity of cropping environments, and as a consequence of more diverse selection pressures (including the « breeder »)
• Improve the linkages and the level of understanding between breeders and farmers
• Better prepare farmers to become involved in cottonseed production
Introducing novel methods in breeding programs

MODELING

Breeding programs generate a lot of data: possible use of Cropping System Models

• Getting a better understanding of GxE interactions
• Testing performance over a wider range of environments compared to actual field evaluations
  ▪ Bringing in physiological traits that matter for yield
  ▪ Ideotyping: Identifying relevant traits to breed for a given environment and management
Introducing novel methods in breeding programs

MODELING

• Breeding for the future: Predicting cultivar performance facing projected climate change

• Evaluating cultivars in silico: Reducing costs and duration of breeding programs

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Developing multi-disciplinary and multi-actor approaches

PROTOTYPING CROPPING SYSTEMS

It brings around the table scattered know-how and experience from different disciplines, experts and stakeholders.
Developing multi-disciplinary and multi-actor approaches

PROTOTYPING CROPPING SYSTEMS

It brings around the table scattered know-how and experience from different disciplines, experts and stakeholders:

• To better understand a specific and complex agricultural situation
• To find, if any, innovative and relevant solutions to solve this problem

Could be used to design cropping systems (including the genetic component) adapted to the massive presence of a disease or to organic growing.
Developing multi-disciplinary and multi-actor approaches

MULTI-ACTOR PLATFORMS
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, knowledge or know-how
- Decision makers look after the strategic decisions and the management of resources
- Facilitators create bonds between the communities of interest
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INTERNATIONAL COLLABORATION

The international companies that are investing in cotton share their experience and know-how across the national boundaries to increase their efficiency and their benefits.

• The national research programs face sometimes dramatic resource shrinkage to serve their national commodity

• They can serve better in joining resources, tools and sharing strategies with neighboring countries that face the same challenges
Promoting the local and regional expertise for collective action

NATIONAL NETWORKING

Various professional communities detain experience and know-how on cotton seed management to share for the benefit of the commodity chain.

• Identify and organize professional communities working on cotton seed production or transformation at the national level
• Facilitate both exchange of experience and expression of their training needs
• Organize training sessions if needed
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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
Conclusion

CIRAD joins the international initiative launched by ICRA

• To promote the sharing of information on existing germplasm collections worldwide

• To agree on common descriptors

• To achieve a more comprehensive assessment of germplasms
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Thank you for your attention
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