Biofortified sorghum: lessons for biotechnology

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The Africa Biofortified Sorghum (ABS) Project started as part of the Bill & Melinda Gates Foundation's Grand Challenges in Global Health (GCGH). The project remains true to the Grand Challenges vision of using a 'specific scientific or technological innovation to remove a critical barrier or solving an important health problem in the developing world that has a high likelihood of global impact and feasibility'.

The project seeks to develop a more nutritious and easily digestible sorghum variety. Deficiency in vitamin A is one of the most prevalent problems in sub-Saharan Africa. Severe vitamin A deficiency has very high mortality rates (60 per cent), but even sub-clinical deficiency is associated with a 23 per cent increase in pre-school-age mortality in areas with endemic vitamin A deficiency.[1] It is this urgency and likely impact that has informed the project's new focus on vitamin A.

Initially, multiple interventions were envisaged. This included increasing levels of essential amino acids (especially lysine) and micronutrients such as iron and zinc and vitamin A. Following the successful development of the 'Golden Sorghum' fortified with pro-vitamin A (beta-carotene), all other interventions were put on hold; the focus is now to develop an early, or first product, with increased levels of pro-vitamin A.

After the initial five-year funding, Du Pont Pioneer secured additional funding from the Howard G. Buffett Foundation (HGBF) to focus on critical technology milestones while Africa Harvest leveraged internal funds to continue with critical non-technical milestones. In less than seven years since the project was initiated, nearly a dozen field trials have been done. Confined field trials (CFTs) have been successfully carried out in the USA, Kenya and Nigeria.

As one of the four agricultural projects funded by the Bill & Melinda Gates Foundation the success and challenges of the project provide important lessons for the future.

Developing African scientific capacity and leadership

The project has contributed significantly to the strengthening of African scientific networks. It pioneered the innovative model of a mutually beneficial relationship with Western scientific institutions. This was achieved through a multidisciplinary core team that helped integrate 13 African and international institutions that formed the ABS consortium. A compelling vision helped African institutions overcome the perception that they would play the role of junior partners. South Africa's Council for Scientific and Industrial Research (CSIR) took R&D leadership. It was the institution through which technology was channelled to the consortium and the continent. Other institutions were identified based on extensive evaluation of infrastructural and scientific capacity. DuPont Pioneer was particularly attracted by the idea of working with an 'Africa-led' consortium and remains committed to the success of the project. Looking back, enormous individual and infrastructural capacity was built, especially with the support of DuPont Pioneer, who hosted many African scientists at their world-class facilities in Johnston, Iowa.

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The critical role of the private sector

It was through my membership on the DuPont Biotech Advisory Panel that I learnt of their successful use of corn gene delivery protocols for sorghum. They had tested the expression of a gene of interest (high lysine storage protein) and several transgenic lines had been created. Three of them had up to 50 per cent increases in lysine. It was this early work that formed the basis of the ABS Project proposal. Later, as the project was implemented, it was DuPont Pioneer's private-sector culture and discipline that enabled the project to make great and speedy progress. Their experience was critical in many ways; perhaps the most important was their ability to shift efforts from a 'science-for-science's-sake' approach to focus the team on producing a viable product.

Intellectual property

As a consortium member, African Agricultural Technology Foundation (AATF) undertook early intellectual property (IP) audits to ensure that no compliance issues were overlooked and that the project had Freedom to Operate (FTO).

Donated IP was checked against the Organisation Africaine de la Propriété Intellectuelle (OAPI) and the African Regional Intellectual Property Organisation (ARIPO). To date, all project IP remains in the public domain and Africa Harvest holds it in trust as a public good.

Biosafety and regulatory capacity

When the project started, only South Africa, Burkina Faso and Egypt had commercialised GM products. The project however played a major role in assisting in the development of strong and effective regulatory policies in several countries. More specifically, the ABS Project's role in the passage of the biosafety laws in Kenya and Nigeria are well documented.

Communication and issues management

The ABS Project pioneered the development of Africa-specific communication tools and stakeholders engagement. Early in the project, Africa Harvest carried out a survey of public perceptions of GM crops to help inform the project's communication strategy and also design how to address biosafety and regulatory issues. Overall, public acceptance of GM technology has increased in Africa. For example, the New Partnership for Africa's Development (NEPAD) has provided leadership through its position on Africa's need for Freedom to Operate. At project level, many biotech projects have built communication protocols based on the ABS Project's experiences.

Balancing commercial interests and country needs

According to Bill Gates, 'it's shocking how little research is directed towards the diseases of the world's poorest countries'. In Africa, it is widely acknowledged that the continent's lack of enthusiasm to embrace GM technology was partly rooted in the lack of research targeting local crops. The ABS Project plays an important role in getting political buy-in, especially in countries where

sorghum plays a critical role in mitigating challenges related to malnutrition and climate change.

In the early days, the consortium's biggest challenge was framing malnutrition as a 'disease of the poor', just as obesity has been described as a disease of the rich. Africa's health challenges are viewed through the lenses of major diseases such as malaria, tuberculosis and HIV-AIDS. The project has successfully managed to link nutrition with the continent's burden of disease. For example, successful HIV-AIDS interventions, such as anti-retroviral, work best when those taking the drugs have good nutrition.

Project and consortium management

Given the large number of institutions involved in the project, Africa Harvest had the role of ensuring that contractual issues were dealt with effectively, that every organisation understood and delivered on its milestone-based strategy, and that a single consortium culture glued things together. An External Advisory Board helped the project get fresh perspectives on how best to implement the project. Among the scientific issues the Board helped identify and deal with were the extent to which gene flow occurred and the need to identify at an early stage locally adapted and high-yielding sorghum varieties.

Funding

The project was very well funded during the first, five-year phase which started in 2005. One lesson learnt after non-extension of funding for phase two is that support from multiple sources is more sustainable than relying on a single funder. Despite funding challenges, in the last two years technological advances have been

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made and there has been a paradigm shift in how Africa views GM crops. The enabling policy framework, good governance, infrastructure and scientific capacities have improved. Societal concerns are being addressed and creative funding structures are being explored. It is anticipated that the nutritionally improved sorghum will be available to farmers in the not-too-distant future.

References

1 McGuire J. (1993) Addressing micronutrient malnutrition. *SCN News* No. 9. Geneva, Switzerland: United Nations Subcommittee on Nutrition (ACC/SCN).

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