



Bt-Cowpea in Nigeria: A Model for Need-Based Use of GM Technology

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Abstract

Recent advances in biotechnology have enabled plant breeders to transfer a gene of interest from other organisms if it is not available in the crop species. This power of genetic modification has led to the development of many novel crop varieties which contain insect and herbicide resistance genes from bacteria such as Bt-cotton, Bt-maize, Bt-brinjal and more recently Bt-cowpea. However, these genetically modified (GM) crops have to go through a long and costly process of regulatory hurdles before release to farmers. Whereas this regulation was initially considered essential to ensure food safety and biosafety, after 25 years and 190 million ha of safe and profitable cultivation, it is the time to promote a need-based development of GM crops such as Bt-cowpea by relaxing the costly and time-consuming process of de-regulation required for their release.

MAIN TEXT

Genetically Modified (GM) crops were first planted in US in 1996, and since then, new GM varieties have been developed in 32 different crops covering 190 million ha in 29 countries and found safe for consumers and the environment [1]. The genetic modification has become an essential tool for plant breeders especially when the desired gene is not available within the crossable gene pool of the crop's genetic resources. The story of Bt-cowpea in Nigeria is the most fitting example in support of GM technology. A Bt-cowpea variety, SAMPEA 20-T with resistance to Maruca pod borer was released in Nigeria in December 2019 and is being grown by over 2000 farmers in 2021 [2]. With ongoing rapid multiplication and distribution, this variety is expected to bring a quantum jump in cowpea production in Nigeria [3] without the need for insecticide to control Maruca pod borer which causes 80 to 100% yield loss if not controlled. The need for and the story of the development of Bt-cowpea in Nigeria is briefly described below which involved several partners and donors sympathetic to Africa.

Cowpea [*Vigna unguiculata* (L.) Walp] is cultivated in over 80 countries and serves as an important source of dietary protein in the drier regions of the tropics and sub-tropics where other food legumes do not perform as well. Nigeria is the largest producer and consumer of cowpea but the cowpea yields are very low due to a number of biotic and abiotic constraints. The International Institute for Tropical Agriculture (IITA) in Nigeria was established in 1967 with a global mandate and started cowpea research in 1970. During the first decade, the scientists concentrated on collection and evaluation of over 15,000 cowpea germplasm lines and screened these for desirable traits. I joined IITA as cowpea breeder in 1979 and initiated a systematic breeding program.

The local varieties were spreading types with 120 to 150-day maturity and susceptible to many diseases, insects and parasitic weeds resulting in yield of less than 500 kg/ha. With required infrastructural and financial support from IITA and technical help from a number of colleagues, we developed a number of '60-70 day' cowpea varieties with erect plant type and yield potential of 2000 kg/ha between 1980 to 2000. These varieties were also bred for resistance to over 12 major diseases, insects such as aphid, thrips and bruchid, nematodes, and parasitic plants *Striga gesnerioides* and *Alectra vogelii* as well as tolerance to drought and heat. However, these varieties were susceptible to Maruca pod borer (*Maruca vitrata*), a devastating pest, because we did not find any resistance to Maruca pod borer in the cowpea germplasm collection. Therefore, farmers were advised to spray insecticide in case of Maruca infestation. These new, short duration and high yielding varieties were distributed for international testing and over 40 countries released them for general cultivation including Nigeria. As a result, the world cowpea production has increased from about one million ton in 1971 to over 8 million tons now [4,5].

Highly impressed with the performance of the new '60-day' cowpea varieties, the USAID Agricultural Officer in Nigeria sponsored a large scale, on-farm demonstration project that enabled a very rapid adoption by the farmers. Since Maruca

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pod borer is a major insect-pest on cowpea in Nigeria, farmers had to apply 2-3 sprays of insecticide which was difficult for small farmers. Therefore, the need for developing a Bt-cowpea with resistance to Maruca pod borer was discussed with USAID officials, Monsanto and other partners. As a follow up, a group meeting comprising IITA, AATF, USAID, RF, Gates Foundation, DFID, Univ. of Virginia, Purdue University, CSIRO Australia, Monsanto Corp., Kirk House Trust and NARS in Africa (IAR Nigeria, INERA BF, CSIR Ghana) was held in 2001 at Dakar, Senegal with the following outcomes:

- i. Monsanto agreed to donate Bt-gene royalty-free for Africa
- ii. Sir Edwin Southern, The Chair of Kirkhouse Trust, agreed to fund biotechnology projects in 4 countries in Africa
- iii. Dr. T.J. Higgins, (The Commonwealth Scientific and Industrial Research Organization (CSIRO) agreed to transform cowpea with the Bt-gene.
- iv. IITA agreed to provide improved cowpea varieties for transformation
- v. The USAID and Rockefeller Foundation agreed to provide funds
- vi. The African Agricultural Technology Foundation (AATF) was tasked to co-ordinate the activities

Cowpea transformation work was started in 2004 and successful events were obtained in 2006 [6]. Among many cowpea varieties, the IITA cowpea breeding line, 'IT86D-1010' was found to be the best for regeneration and therefore, transformed with the Bt-gene. Since there was no established biosafety protocol in Africa, the transgenic Bt-IT86D-1010 was first tested in Puerto Rico in 2008 and subsequently, from 2009 onward it was tested in Nigeria, Burkina Faso and Ghana. Results showed 90-100% control of Maruca pod borer. This trait was then backcrossed to IT97K-499-35 cowpea, the most promising variety with resistance to major diseases and insects as well as Striga and Alectra parasitic weeds [7]. After several years of contained testing and field trials, the IT97K-499-35 BT was released in Nigeria in 2019 as 'SAMPEA 20-T' [2] and was planted by farmers from 2020 crop seasons and it is growing exponentially since then [3].

The successful development and release of Bt-cowpea in Nigeria as an essential complement to conventional breeding is the result of intensive negotiations, sympathetic considerations and hard work of many scientists, donors and international collaborators. The government and people of Nigeria have accepted Bt-cowpea in spite of numerous anti-GMO demonstrations because cowpea is a very important food crop in Nigeria and the fact that other Bt-crops have been found to be safe for the consumers as well as the environment for over 25 years. With such a powerful tool in

the hands of the plant breeders and long-term, proven safety record, the GM technology should be considered an integral part of the Plant Breeding process and GM crop varieties should be treated the same way as other conventional varieties for public release and not subjected to costly and decade-long process of deregulation.

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