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Farmers' knowledge and opinions towards bollgard II® implementation in cotton production in western Burkina Faso

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ABSTRACT

In 2008, the commercial cultivation of Genetically Modified (GM) cotton (Bollgard II®) started in Burkina Faso. The adoption rate increased rapidly in subsequent years to reach around 70% in 2014. Although some criticisms were raised concerning the suitability of the technology for the farming system in Burkina Faso, the introduction of transgenic cotton in the country was generally regarded as a great success. Despite this, during the 2016–2017 agricultural campaign, the government of Burkina Faso decided to suspend the cultivation of Bollgard II®. In this context, this paper investigates farmers' knowledge, perceptions, opinions and attitudes towards Bollgard II® as well as their views on the recent decision to suspend its cultivation. Data was collected from 324 cotton farmers, both growers of conventional and Bollgard II®. The results showed that the farmers surveyed had a poor knowledge concerning the core concepts of biotechnology and Bollgard II® in particular. Moreover, the regulatory oversight of the implementation of the technology was found insufficient, as illustrated by the lack of compliance with prescriptions concerning refuge areas and pesticide treatments. Nevertheless, overall, the farmers interviewed had a slightly positive opinion about the effects on yield, income and their wellbeing. In particular the reduction in pesticide treatments was perceived very positively by all respondents. Although the study finds that the majority of farmers disagreed with the recent suspension of Bt cotton cultivation by the government, it also makes clear that a thorough debate on the technology and its implementation is necessary.

Introduction

Cotton (*Gossypium* L.) is one of the most important cash crops in West Africa and is a vital catalyst to economic development in the region [1]. In Burkina Faso, despite the recent reduction in the share of export earnings for cotton in favor of gold [2], cotton still remains the most important agricultural crop. In fact, the cotton sector not only provides labor for more than 350,000 farmers but also indirectly contributes to the livelihood of more than 3 million people, taking into account the entire chain and that of by-products, such as local oil factories and cattle food producers.

Around the year 2000, the government of Burkina Faso became interested in Genetically Modified (GM) cotton. At that time, the cotton sector in many developing countries was facing considerable problems with pest damage [3], a problem aggravated by global warming [4]. This interest was stimulated by the deteriorating socio-economic situation in the cotton sector [5] and by the findings of Burkina Faso's National Agricultural Research Center (INERA) concerning the decreasing effectiveness of conventional chemical spraying methods [1] and their negative environmental and health impacts.

In collaboration with Monsanto, INERA began a 5-year program of field testing of Bollgard II®, a second generation of *Bacillus thuringiensis* (Bt) improved cotton [1]. In parallel to the field testing, biosafety legislation and protocols governing regulatory oversight and approval of biotechnology products were developed by the government. Two regional Bollgard II® varieties were developed in 2008 and the Burkina National Biosafety Agency authorized these two Bt varieties for seed production and commercialization by national cotton companies. This was a significant milestone for Burkina Faso, being the first commercial use of Bt cotton in the country and the third commercial release of a GM crop in Africa [1,6,7].

However, this move was not viewed positively by all stakeholders. As in many developing countries, the debate around the adoption of biotechnology in agriculture is still ongoing and lags behind the

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technology uptake. The opponents of GM crops have argued that the introduction of agricultural biotechnology could threaten the survival of indigenous crops and would negatively affect biodiversity [8]. Besides, in Burkina Faso, the lack of farmers' knowledge regarding the correct use of Bt-technology was one of the main concerns of the opponents of GM crops. Along the same lines, Renaudin et *al.* [5], questioned the appropriateness of introducing GM cotton into the peasant production systems in Burkina Faso. They point to the lack of information disseminated to the cotton farmers regarding management of secondary pests and the concept of refuge areas, which are essential aspects of this new technology. Also Vitale et al. [6] show that this concern might be valid because farmers did not perform the recommended two late-season treatments to target the secondary pests that are not controlled by the Bt-technology.

The introduction of Bt cotton in Burkina Faso is often described as a success. For example, Vitale et al. [6,7,9,10], in a series of follow-up studies, report the rapid spread (covering 70% of the cotton area), yield performance (15–20% increase), improved economic returns for smallholder farmers and the health and environmental benefits due to reduced pesticide use. Other authors, such as Renaudin et *al.* [5] and Dowd-Uribe [11], are more critical and state that the social and agro-ecological context of adoption is not given sufficient consideration.

Moreover, there is a growing awareness among researchers that the voice of farmers needs to be heard in the GM debate [12]. In the light of the recent decision [13] by the Government of Burkina Faso to suspend the production of Bollgard II® cotton, and given the criticism that both the spread and suspension of Bt cotton happened in a top-down way, it is interesting to focus on the farmers' perspectives concerning this technology. In this framework, three objectives were identified. The first objective was to gauge farmers' understanding and knowledge about the concept of biotechnology and, more specifically, Bt-technology. The second objective was to assess the attitudes of farmers towards Bollgard II® and the third objective was to look at their experience with the Bollgard II® crop and their views on the decision to impose a suspension on its cultivation.

Background

Cotton was introduced in Burkina Faso in the 20th century [14]. Over time, Burkina Faso's cotton sector has seen lots of changes, among them the liberalization of the sector [15] as well as the creation of a special research program dedicated to the improvement of cotton production. Furthermore, in 1998, the National Union of Cotton Producers (UNPCB) was established in order to give farmers a voice in decision making. To date, the sector is administered by a dominant parastatal company (Sofitex) and two private companies (Socoma and Faso Coton). The traditional vertical integration between farmers and companies, in which the cotton industries provide inputs, such as seeds, pesticides, fertilizers, and technical advice still exists [16].

In 2008, Burkina Faso became the third African country, after South Africa and Egypt, to commercialize Bt crops [17]. The 2008 approval and production of seeds paved the way for the planting of 125,000 ha of Bollgard II® cotton in Burkina Faso in 2009 – the most extensive single-year biotechnology launch in Sub-Saharan Africa (SSA) to date [6]. In addition, one year later, the adoption rate had already increased to 29% and by 2014 it had reached 70% or a total of 454,124 ha [17,18]. In 2016, Pertry et al. [19] described the Bollgard II® case in Burkina Faso as a role model for sustainable cotton production.

Bollgard II® cotton requires only two insecticide treatments to control secondary pests such as aphids and jassids. This is in contrast to conventional cotton which requires six treatments, with the initial four targeting Lepidoptera and the last two targeting secondary pests. Growing Bollgard II® cotton was expected to increase yields by up to 30% and to reduce pesticide use with positive effects on farmers' health and the environment. INERA also recommended that the cotton companies and the farmers' union (Union Nationale des Producteurs de Coton du Burkina, UNPCB) emphasize the need for effective implementation of two late-season treatments in order to guarantee yield improvement and compliance with structured refuge areas to prevent development of resistance to Bt toxins.

Overall, the effectiveness of Bollgard II® in terms of pest control was not questioned. There were only some concerns with respect to the financial risks for smallholders due to the high cost of the Bt seeds [5] or about the lack of an integrated pest management strategy by the cotton producers [5,6]. Nevertheless, in 2012–2013, the cotton companies reported a shorter fiber length in comparison to previous years. According to INERA, this observation was reported to Monsanto and both agreed to investigate the cause. In 2014, the use of the Bollgard II® variety was determined as the main source. In order to avoid cotton companies losing money on the international market owing to reduced fiber length, the tripartite framework (Monsanto, INERA and cotton companies) initially agreed to reduce the Bt cultivated land to 50% while trying to fix the genetic issue over a period of 3–5 years. In 2015, however, the permanent consultative framework (Association Interprofessionnel du Coton au Burkina, AICB) incorporating the government, the cotton companies and the UNPCB, urged for the suspension of Bollgard II® cotton cultivation and this decision was endorsed in 2016 by the government of Burkina Faso. This means that in 2016 only conventional seeds have been distributed by the cotton companies in Burkina Faso.

Materials and methodology

Study sites and sampling design

The study was conducted during the 2015–2016 agricultural season in western Burkina Faso – an area administered by SOFITEX (Societe Burkinabe des Fibres Textiles). Sofitex is the largest of three cotton companies (see Fig. 1) covering more than 85% of the cotton cultivated land and representing about 80% of the national cotton production [2]. Three districts (Dedougou-Bobo-Diebougou) were chosen along a north-south gradient presenting different agro-climatic characteristics. These districts include 7 of the 13 Sofitex cotton ginning factories. A total of 12 villages were selected for the study (4 per district). Given that cotton farmers are organized into groups in Burkina Faso (Groupement de Producteurs de Coton, GPC) at village level, and their individual interests could differ depending on the type of farmer (Small, Medium, Large) and/or the cotton variety grown (Bt or non-Bt), the sample was designed to allow a pairwise comparison between the growers of the different varieties as well as between the types of farmer. The position occupied by farmers in their GPCs (president, active member or simple member) was also considered. In total, 324 farmers were selected. Classification of farmers was made based on the total cotton acreage grown and the number of cattle pairs used for labor.

Structure of the questionnaire

The questionnaire focused on the appraisal of farmers' knowledge, perceptions, opinions and attitudes towards GM cotton production in Burkina Faso, as well as on their experience. The structure of the questionnaire is summarized in Table 1 (see annex). For instance, to gauge farmers' understanding about the use of Bt-technology, 4 statements were developed to which the farmer could answer Yes/Not sure/No. Furthermore, 7 and 3 point Likert scales were used, respectively, to measure farmers' opinions about the advantages of Bt-technology and about the recent decision to suspend Bollgard II® cotton production. Throughout the questionnaire, statements were formulated, both in positive and negative ways, in order to test the consistency of the responses given by farmers.