China Economic Review 33 (2015) 67–75

Contents lists available at ScienceDirect

China Economic Review

# Biosafety management and pesticide use in China's Bt cotton production

Jikun HUANG [a,*], Ruijian CHEN [a,b], Fangbin QIAO [c,*], Kongming WU [d]

[a] Center for Chinese Agricultural Policy, Chinese Academy of Sciences and Institute of Geographic Sciences and Natural Resource Research, China
[b] Foreign Economic Cooperation Center, Ministry of Agriculture, China
[c] China Economics and Management Academy, Central University of Finance and Economics, China
[d] State Key Laboratory for Biology of Insect Pests and Plant Diseases, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, China

ARTICLE INFO

*Article history:*
Received 16 April 2014
Received in revised form 3 January 2015
Accepted 6 January 2015
Available online 10 January 2015

*JEL classification:*
Q12
Q16
O13

*Keywords:*
Biosafety regulation
Pesticide use
Bt cotton
China

ABSTRACT

As the rapid development of Genetically Modified crops, Chinese government has been increasing its efforts in GM crop biosafety management. However, the rapid expansion of *Bacillus thuringiensis* (Bt) cotton varieties and less regulated seed industry also resulted in a large amount of Bt cotton varieties that bypassed China's biosafety regulations. This study shows that the Bt cotton varieties without biosafety certificates (BC) have been widely used by farmers in practice. Econometric analysis further shows that the Bt cotton varieties with BC outperform the varieties without BC in terms of pesticide use. The paper concludes with policy implications.


## 1. Introduction

The multiple benefits and success of *Bacillus thuringiensis* (Bt) technology have been well documented in major countries where Bt crops were planted (Hurley, Secchi, Babcock, & Hellmich, 2001; Pray, Ma, Huang, & Qiao, 2001; Qaim, 2003). For example, the empirical studies in China showed that Bt cotton adoption has derived significant and multiple benefits, including increasing yields and falling production cost from the reduction of pesticide applications (for example, Huang, Hu, Pray, Qiao and Rozelle, 2003; Huang, Hu, Rozelle, Qiao, & Pray, 2002). Such gains also have been translated into economic, human health and environmental benefits (Hossain et al., 2004; Kouser & Qaim, 2013). In developing countries, Genetically Modified (GM) crops also have contributed to poverty reduction, improvements of nutrition and food security (Qaim, 2010). In addition, empirical studies showed that the benefits that GM crops had generated are stable in a longer-term (Kathage & Qaim, 2012; Smale et al., 2009).

However, along with the above positive evidences, significant opposition to GM technology has aroused. The negative attitudes often seem to dominate the public debate on the advantage and disadvantage of GM technology, especially in recent years (Cleveland & Soleri, 2005; Kathage & Qaim, 2012). Those against GM technology worry that the widespread of GM crops would damage environments and human health and have adverse social implications (Friends of the Earth, 2008; Sharma, 2004).

* Corresponding authors.
*E-mail addresses:* jkhuang.ccap@igsnrr.ac.cn (J. Huang), qiaofangbin@cufe.edu.cn (F. Qiao).

http://dx.doi.org/10.1016/j.chieco.2015.01.006
1043-951X/

Due to the rising public reservations and the existence of externalities, the GM technology is heavily regulated (Qaim, 2009). For a novel technology, regulators are extremely cautious to make sure that the food produced under this novel technology is safe for human and environments. At the same time, the rising opposition also gives the government high pressure to regulate GM technology strictly. As a result, GM seed varieties are heavily regulated in most countries where GM crops were planted (Qaim, 2009). For example, according to regulations released in China, no GM crop varieties without biosafety certificate (BC) can be sold in the market (Huang & Wang, 2002).

One of the consequences from strict biosafety regulation is the widespread of unapproved varieties in practice. Well-established and implemented regulations can strike low quality seeds (for example those without biosafety certificate) out of market and benefit both the farmers and consumers. However, no benefit comes without cost (Smale et al., 2009). Strict regulation and high cost associated with regulatory process have prevented some seed companies, especially those small seed companies, from applying for official certificates (Pray, Huang, et al., 2006). On the other hand, weak intellectual property rights (IPR) makes getting genetic materials easy and less expensive in developing countries. Consequently, even small seed companies can produce their own varieties. Moreover, the existence of tens of thousands of seed companies/dealers makes implementing seed laws and regulations and monitoring violations a hard work (Huang, Chen, Mi, Hu, & Osir, 2009). All these factors, working together, make unapproved varieties quite common in practice (Herring, 2007).

The existence of the unapproved varieties raised several questions. For example, how serious are unapproved varieties (or the varieties without BC) in farm field? More importantly, how is the efficacy of these Bt cotton varieties without BC in controlling insects in field production? Do farmers consider the Bt cotton varieties without BC different from those varieties with BC? In other words, do farmers spray more pesticide in fields where varieties without BC are planted than in the fields where varieties with BC are planted?

The overall goal of this study is to empirically answer the above questions. To meet this overall goal, we have three specific objectives. First, we provide a profile of China's biosafety regulations and seed market. Second, using survey data collected in Northern China Plain, we document the share of cotton varieties without BC and descriptively chart the way that farmers appear to spray more in plots planted with varieties without BC than those planted with varieties with BC. Finally, we empirically estimate whether BC, all other things equal, are associated with farmer' pesticide use by estimating multivariate regression econometric models.

The rest of the paper is organized as follows. Section 2 briefly provides background information on China's biosafety regulations and the existence of varieties without BC in China's cotton seed market. The data collected from farm household surveys are described in Section 3. Then we empirically examine the efficiency of these two types of Bt cotton varieties (i.e., varieties with BC and varieties without BC) through their performance in farmers' fields. Discussion and policy implications from this study are provided in the final section.

## 2. China's biosafety regulations and varieties without BC

As the rapid development of GM industry, the Chinese government has paid great attention to the biosafety management of GM crops (Huang & Wang, 2002). In early 1993, the Chinese State Science and Technology Commission (SSTC) released the first set of biosafety regulations, the “Safety Administration and Regulation on Genetic Engineering” (Chinese State Science and Technology Commission, 1993). Following the SSTC's regulations, the Ministry of Agriculture (MOA) issued the “Implementation Measures for Agricultural Biological Engineering” in 1996 (MOA, 2005). Since then, the policy and regulatory on biosafety have become more stringent. In May 2001 the State Council decreed a new set of policy guidelines, the “Regulations on the Safety Administration of Agricultural Genetically Modified Organisms (GMOs)” to replace the early regulations issued by SSTC in 1993. MOA also announced three new implementation regulations to replace their earlier rules. The new framework, which took effect in March 2002, greatly expanded the scope of regulation to include more detailed rules on biosafety management, trade and labeling of GM food products. These laws and regulations consisted of general principles, safety categories, risk evaluation, application and approval, safety control measures, and legal responsibilities.[1]

In addition, special institutions in charge of the formulation and implementation of biosafety regulations on agricultural GMOs and their commercialization were established. The National GMOs Biosafety Committee was established in 1997 when the first GM crop, Bt cotton, was commercialized. As a major player in the process of biosafety management, this committee evaluates all biosafety assessment applications related to experimental research, field trials, environmental release, pre-production and commercialization of agricultural GMOs. It provides recommendations (approval or disapproval) to the Office of Agricultural Genetic Engineering Biosafety Administration (OGEBA). The OGEBA is responsible for the final decision on whether to approve an application. If the commercialization of a GM crop is approved, the applicant will receive a BC for commercialization.

Biosafety regulation institutions have been also established at agricultural bureaus at local levels (i.e., province and county). These local institutions are mainly in charge of the monitoring and reporting GM crop production and marketing at their own region after approval of GM crop commercialization by MOA. However, based on our field interviews, capacity of most local biosafety regulation institutions is weak.[2] Given largely unregulated seed markets in China, which is further discussed below, the actual role of monitoring GM crop production and marketing is very limited.

[1] The detailed discussions on China's biosafety regulations, tests, process and application have been published in the literature (for example, Huang & Wang, 2002; Pray, Ramaswami, et al. 2006).

[2] Monitoring and management of agricultural GMOs are side works of local agriculture bureau. And because there are tens of thousand seed companies/dealers, it is reasonable to assume the cost of violations of agricultural laws and regulations is quite low as the probability of being caught and punished is very low (Huang & Wang, 2002; Pray, Ramaswami, et al., 2006).