Development and Application of Transgenic Bt Cotton in China

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Abstract: China is the largest cotton-producer in the World with about 7 million tons of lint produced annually, which accounts for around 30% of the world's total production. Damage from pests is one of the major limiting factors for cotton production in China, where over 100 pest species have been recorded to attack cotton. The key pests are seedling diseases, boll diseases, *Fusarium* wilt, *Verticillium* wilt, cotton aphid, red spider mites, cotton bollworm and pink bollworm. The yield losses due to damage from those pests are estimated to 10-15% of the potential production, even up to 30% upon their outbreaks.

Chemical control is one of the major measures for cotton pest management. Owing to the heavy dependence upon the application of pesticides, it causes, however, the serious problem of "3R" (resistance, resurgence and residues). Breeding the host-plant resistance has been considered the effective and economic approach for cotton pest control. While, it is a slow process to gain an ideal cultivar for production through the conventional breeding. Biotechnology has been thought the most efficient way to breed crop varieties highly resistant to target pests. In 1980's, scientists from USA successfully inserted the foreign Bt toxin gene into cotton and bred several cotton cultivars with that gene. They showed a high resistance to lepidopterious pests, especially to cotton bollworms. Soon after that, the Chinese scientists followed this new research trend and made a milestone progress in this field.

So far, several genes have been constructed, such as the single gene (Bt), the double genes (Bt+CpTI), and the tribal genes (Bt+CpTI +Go, Bt+CpTI+GNA, Bt+CpTI+herbicide resistance, Bt+CpTI+male sterile). Three methods for genetic transformation have been applied, including *Agrobacterium*, pollen-tube path way and gene gun, with the transforming efficiency of 5%, 2% and 8%, respectively. Over 20 Bt cotton cultivatrs have been released in production, and their acreage reached to 4 million hectares in 2007 which accounts for over 70% of the nation's total.

The transgenic Bt cotton shows high resistance to lepidopterious pests (especially to bollworms), while less impacts on the sucking pests like cotton aphid, red spider mites, and so on. It increases abundance of predator populations, while decreases that of parasitoid ones. The Bt cotton-based IPM system has been established, with the bio-ecological regulation at the early and the late seasons while the chemical control at the mid season. The monitoring system for Bt toxin resistance has been also established, including the screening in lab and testing in field. Results from resistance monitoring show that there is a high potential for the cotton bollworm to develop resistance to Bt toxin in lab, while there is, so far, no resistance detected in the field.

Extension of transgenic Bt cotton has brought about significant economic, social and ecological benefits. In terms of the economic benefit, value from the saving of insecticide application amounts to 120-150US$ per hectare, and that from the increased yield is 150-200US$ per hectare. In terms of the social benefit, the labor-hand is decreased by 20-30% and the poisoning incidence while spraying decreased by over 90%. In terms of the ecological benefit, the abundance of beneficial species is increased by 20-40%. Thanks to extension of the transgenic Bt cotton, the cotton production has been stabilized, the vatrietal structure has been optimized, and capability for market competition has been enhanced.

With respects to the transgenic Bt cotton in future, the improvement should be more stressed on increase in resistance with the time and tissue specification. The application should be more emphasized on establishment of an efficient system for Bt toxin resistance management.