Biotech Cotton and the Technology Fee

(China, Mexico and the United States)

The article on this topic published in the March 2009 issue of the *ICAC RECORDER* covered the technology fee in Argentina, Australia, Brazil, Burkina Faso, Colombia, India and South Africa. The present article deals with the remaining three countries, i.e., China (Mainland), Mexico and the USA, thus bringing our coverage up to the 10 countries that have commercialized biotech cotton so far. (Indonesia is not included because biotech cotton is no longer approved there.) Many sources, including informal contacts, were used to compile the data. Some of the data is official and much of the rest may have varying degrees of reliability.

The technology fee, varies among states, provinces and regions, but some of the following reasons may also account for diminished reliability of technology fee data:

- There are many seed companies that supply planting seed and each may have its own price.
- Companies try to keep price information confidential; this is usually considered sound business tactics.
- Six out of the ten countries growing biotech cotton commercialized it over 10 years ago, and not all of them have kept track of a series of data lines for all traits.

China (Mainland)

China put Monsanto's Bollgard® cotton into commercial production back in 1997/98. Monsanto, Delta and Pine Land Company and the Singapore Economic Development Authority formed a joint venture with Hebei Provincial Seed Company and, after approval by the Chinese Biosafety Committee, started selling DPL variety 33B in 1997. In China, commercial cotton hybrids as well as straight varieties are planted at the same time. The hybrid seed is sold in 500 gm or 350 gm packets and, on the average, farmers use about 5.25 kg seed/ha obtaining about 30,000 plants/ha. The varieties seed is planted at an average rate of 15 kg/ha, with some farmers using as little as 12.5 kg/ha and others using as much as 17.5 kg/ha, thus introducing a non-trivial difference in the technology fee per hectare.

In 1997, China was also ready with its locally developed insect resistant biotech cotton commonly called "Guokang" (CPTi-Cowpea trypsin inhibitor gene). To market "Guokang" cotton, the Chinese Academy of Agricultural Sciences (owner of the technology) had its Biotechnology Research Center form a joint venture with a real estate company based in Shenzhen (located in southern Guangdong Province) and transferred the "Guokang" cotton to it. The joint venture, called Biocentury Transgene Technology Limited, sub-licensed the technology to over 30 private and provincial seed companies in China. As a major stakeholder in the Biocentury Transgene Technology Company, the Chinese Government had a say in fixing the technology fee. The license fee was collected as a lump sum payment of US$60,000 per annum per company regardless of their sales.

There are conflicting reports about differences in the efficacy of the two types of biotech genes, and having a technology fee that was lower than the one for Bollgard was certainly a factor, but they were not the only factors that attracted farmers to Guokang; cotton producers favored a local product over a foreign one and quickly started replacing Bollgard varieties with Guokang hybrids. There was one more difference in the two types of technologies. Bollgard was sold in the form of varieties while Guokang was mainly sold as commercial cotton hybrids. This explains why hybrids are now more popular in the Yellow River Valley and the Yangtze River Valley. It is estimated that in 2003/04, each event covered almost half of the biotech cotton area in China. Guokang had replaced all Bollgard cotton by 2008/09.

Biotech cotton spread at a practically uniform rate in the Yellow and the Yangtze River Valleys. By 2006/07, most of the cotton planted in Hebei, Shandong, Jiangsu, Shanxi, Henan and Anhui provinces was biotech. Insect-resistant biotech cotton was favored in China because before the introduction of biotech cotton, resistance to insecticides had become a big problem. China was in real need of an alternative control

Price of Biotech Planting Seed in China (Mainland)

Year	Bollgard (In US$/Ha)	Guokang (In US$/Ha)	Seed Rate/Ha (Kg)	Exchange Rate/US$ (Yuan)
1997/98	45.2		15	8.3
1998/99	45.3		15	8.3
1999/00	45.3	3.6	15	8.3
2000/01	45.3	3.6	15	8.3
2001/02	45.3	3.6	15	8.3
2002/03	45.2	3.6	15	8.3
2003/04	45.2	3.6	15	8.3
2004/05	45.2	3.6	15	8.3
2005/06	45.2	3.6	15	8.3
2006/07	46.6	3.7	15	8.1
2007/08	38.6	0.2	12	7.8
2008/09	34.7	0 to 0.21	10	7.2
2009/10	36.5	0 to 0.22	10	6.9

Note: The exchange rates are for February 15 of each year, which is the high season for seed sale.

measure. China had already begun implementing its integrated pest management (IPM) plans to tackle the resistance problem, but if biotech cotton had not been introduced in China when it was, the cotton situation in the country would be very different today. So far, only the insect-resistance trait has been approved in China. There is no mandatory refuge requirement in China because the Chinese Biosafety Committee is of the opinion that thanks to the broad diversity of crops in both Valleys, other crops, like soybean and maize, play the role of refuge crops. Biotech cotton is not approved for the Northwest region.

In the beginning, Monsanto/Deltapine charged almost the same technology fee as in the USA, i.e. $45/ha or US$2.3/kg. In fact, farmers were paying not only for the Bt gene, but also for improved cultivars and seed quality (higher germination). However, because of the small-scale farming system prevalent in China, particularly in the Yellow and the Yangtze River Valleys, it was not possible for Monsanto/Deltapine to sign direct contracts with individual farmers. On the other hand, the Biocentury Transgene Technology Company liberally provided licenses to seed companies. The institution responsible for developing Guokang is also said to receive some kind of royalty payment, but it was all a government system so the situation was quite fluid. Therefore, different sources report the technology fee differently.

The technology fee was also different for official and unofficial seeds sold on the market. Due to the one-time payment of a lump sum royalty per year, the technology fee system in China became fluid affecting the Bollgard type of biotech cotton as well. The upside of the Chinese system appeared in the form of a very low technology fee, quick adoption of biotech cotton on a vast area and a quick switch-over to the local variety of biotech cotton. The table above contains the spread of mean prices as supplied by different sources. While they may not be exact, they may be expected to be close approximations.

Conventional planting seed is sold at the rate of US$7.5-8.75 per kg (60-70 Yuan or RMB per kg) for hybrids and US$.75-1.25 per kg (6-10 Yuan or RMB per kg) for pure varieties.

Mexico

According to Traxler and Godoy-Avila (2004) there are two types of producers in Mexico – *ejidos* and small landholders. The *ejido* producers or *ejidatarios* are very small producers whose holdings were formed during one of Mexico's several land reforms. The average size of *ejido* holdings is 2-10 ha and that of the small landholders, 30-100 ha. Most cotton producers are organized into farmer associations for the purpose of obtaining credit and technical assistance. There is no obligation to be a member of an association, but wherever there is an association, it has centralized accounting, management and technical staff. Within an association, a number of growers may get together to perform their field operations. In most cases, the individual landholders have relatively little involvement in the technical decision-making process, deferring to the judgments of consultants. Because of the link that the associations provide with credit providers, they serve as a very effective conduit for information about new technologies and have undoubtedly served to speed up the adoption of Bt cotton varieties.

In Mexico, the most important insect pests are pink bollworm (*Pectinophora gossypiella*), boll weevil (*Anthonomus grandis*), tobacco budworm (*Heliothis virescens*), and cotton bollworm (*Helicoverpa zea*), but fall armyworm (*Spodoptera exigua*), whitefly (*Bemisia argentifolii*), and conchuela (*Chlorochroa ligata*) also cause crop damage and require treatment in some areas. Biotech cotton was introduced from the USA in 1996/97. The biotech cotton planting seed contracts obligated farmers not only to refrain from saving seed, but also to have seedcotton ginned only at authorized gins. Monsanto contracted entomologists to supervise the farmers' compliance with biosafety standards. The contracts also allowed Monsanto free access to the area planted to cotton. Additionally, Monsanto hired entomologists during the season to make random verification checks. These representatives were equipped with field kits designed to test for the presence of the Bt gene at a minimal cost. The contractually specified penalty for selling illegal seed was 120 times the purchase price, which was high enough to prevent large-scale violations.

Monsanto's contract with ginners was another check on farmers that limited the illegal use of biotech seeds. Monsanto was able to collect seeds from gins, and gins were also obliged to open their facilities and transaction records to Monsanto for inspection. Farmers who were identified as requesting the return of the seeds after ginning were subject to field visits by Monsanto in the following season. The system worked

Price Cotton Planting Seed in Mexico – 2008/09 (US$)
(Price of 250,000 Seed Count)

Seed Type	Seed Price	Technology Fee	Total
Bollgard	85.0	90.0	175.0
Roundup Ready	85.0	110.0	195.0
Bollgard+Roundup Ready	85.0	190.0	275.0
Roundup Ready Flex	85.0	135.0	220.0
Bollgard II+Roundup Ready Flex	85.0	230.0	315.0
Conventional	85.0		85.0

well, and the illegal spread of biotech seed was kept to a minimum.

The technology fee varied greatly by growing regions (Traxler *et al.*, 2000). For example, in South Tamaulipas, the technology fee is more than three times that of South Sonora, where the budworm-bollworm complex problem is the lightest. The differential pricing strategy is based on differences in the marginal value product of Bt cotton seed caused by differences in pest pressure and seed drop rates.

Price for Bt Seed by Growing Region in Mexico – 2000/01

Region	Bt Seed Price (US$/22 kg bag)
Comarca Lagunera	105.45
Tamaulipas	179.26
North Tamaulipas	80.05
South Chihuahua	90.45
North Chihuahua	61.81
South Sonora	50.40
North Sonora	105.45
Sinaloa	59.95
Baja California	85.05

A twenty-two kilogram packet of seed contains about 250,000 seeds. The table from the previous page contains data from the 2008/09 season on the technology fee for a packet with a seed-count of about 250,000 covering various traits. The price of a bag of seed with the Roundup Ready or Roundup Ready Flex traits also included 5 liters of Roundup. The price of the seed was separate. A 250,000-seed packet is enough to plant 1.5 hectares. A bag with the same number of conventional seeds costs about US$85.

USA

In the U.S., many traits have been approved and many companies are involved in the supply of planting seed. Each company has its own technology fee for its proprietary traits, but almost all seed companies offer risk management programs. Different companies have different names for these programs, but the main objective is to provide at least some assurance in case the seed does not germinate properly or there is a heavy loss in yield due to natural disasters. So, when growers buy seed and pay the technology fee, they automatically become entitled to the company's program benefits. The risk/guarantee

programs vary by production area and also carry certain other limitations, but in general, they cover the following two contingencies:

- **Replanting** – Most companies provide free replanting seed of the same variety or of another variety of seed if the same biotech variety is not available, but this facility is exclusively for the first replant. On the other hand, some companies provide full reimbursement of seed and technology fee costs when time limitations do not allow for replanting of the crop. Some times companies will visit farms to verify that conditions actually warrant replanting, and still other companies require a minimum affected area before they will sanction replanting seed or waiver of the fee, whatever the case may be. The companies may commit exclusively to reimbursing the technology fee, but only for some types of biotech seed and not all brands. There is always a certain deadline date (that varies by production area) by which growers have to report to the seed company that they need replanting or that replanting was required but there was no time to replant.
- **Crop loss** – The crop loss options also vary by company, type of biotech variety and production region. Some companies may not offer any crop loss program at all; all of them, however, change their requirements every year. Most companies offer a 100% refund of the technology fee if there is total loss or if the average yield is below 168 kg lint per hectare. Eligibility requirements to opt for the crop loss program are stricter than they are for the replanting program. For example, growers who fail to protect their crop against pest attack are not eligible for crop loss protection.

Seed companies restrict their replanting and total loss benefits solely to their own brand varieties. The programs change from year to year and farmers are advised to be aware of the options before they buy the planting seed. Monsanto/Delta and Pine Land varieties are usually planted on over 40% of the cotton area in the U.S., and the 2009/10 Monsanto program has two options in addition to crop loss.

- **Trait Replant Refund** – If a grower replants an eligible crop containing a Monsanto trait to another eligible Monsanto trait crop, the grower gets replant protection on his initial trait investment through Roundup Rewards®.
- **Seed Replant Protection** – If a grower plants an eligible Deltapine, Asgrow or DEKALB seed and replants to another eligible Deltapine, Asgrow or DEKALB seed, the grower gets replant protection on his second crop's seed investment.

The technology fee structure has changed drastically in the U.S. It used to be based on area, but, in 2004/05 it was pegged to the seed drop rate. The seed drop rate varies by planting method: solid or skip row, rainfed or irrigated, narrow row or ultra narrow row planting, conservation tillage system, etc. Another factor, one that is even more significant, is the geographical variation in price. The price of planting seed and the technology fee in the USA vary greatly from state to state and from trait to trait. This is why this article contains data solely for the Mississippi Delta Region. There are no data available for WideStrike, WideStrike+Roundup Ready, WideStrike+Roundup Ready Flex and Bollgard II+Liberty Link, all of which are also approved for commercial production. The table on the next page indicates that the cost of conventional seed may, in some cases, be unexpectedly high and the reason is that in regions that are intensively biotech, conventional seeds tend to be scarce or even unavailable.

Other Countries

Biotech cotton is still not approved in Pakistan but spurious seeds have been around for quite a few years and occupy a significant area. However, Monsanto entered into an agreement with the Ministry of Food, Agriculture and Livestock to allow it to run official tests of biotech hybrids under Pakistani conditions. Four Bollgard II hybrids of Indian origin were tested at multiple locations during 2008/09. Furthermore, it is reported that Monsanto is currently negotiating with the Ministry to settle the technology fee issue, but despite newspaper accounts indicating that a technology fee of about US$52/ha may be in the works, at the time of publication of this report no firm agreement had been reached. Pakistan is also said to have imported a ton of biotech seed from China (Mainland) for testing at farmers fields.

In Pakistan, an average of US$100/ha are spent to control sucking insects and the target insects controlled by Bollgard II genes. Bollworms have traditionally been a great threat to cotton production in Pakistan, mainly prior to the appearance of the leaf curl virus disease in 1992/93. Currently, all commercial varieties are resistant to the leaf curl virus disease, but in the last few years a modified form of the virus called the "Burewala" strain has wreaked havoc on cotton farming. No variety has been found that is resistant to this virus and, coupled with this problem, the mealy bug has become a major pest. Effective chemical control is not yet available either against the Burewala virus or the mealy bug. The complex pest situation in Pakistan has encumbered and delayed the official introduction of biotech cotton in the country.

A number of other countries are formally testing biotech cotton under confined conditions. The countries that have completed, or are close to completing, most of the requirements for commercialization of biotech cotton are Kenya, Malawi and Uganda. (There are no indications from these countries on the question of the technology fee.) Uganda has designed a protocol to test biotech cotton, but the final decision to authorize commercial adoption has not been made yet. Uganda will undertake its first field trials in 2009/10. However, the fact that a country has initiated trials does not necessarily

Technology Fee for Biotech Cotton in the Mississippi Delta Region, USA

Year	Fee in US$										
	BXN	Bollgard	Bollgard II	RR	RR Flex	BG + RR	BG + RR Flex	BG II + RR	BG II + RR Flex	Liberty Link	Conven. Seed
1995/96		1.87/kg+74.1/ha	-	-	-	-	-		-	-	1.87/kg
1996/97		2.21/kg+79.1/ha	-	-	-	-	-		-	-	1.9/kg
1997/98		2.27/kg+79.1/ha	-	2.25/kg+NA	-		-		-	-	2.03/kg
1998/99		2.38/kg+79.1/ha	-	2.36/kg+NA	-		-		-	-	2.12/kg
1999/00		2.25/kg+79.1/ha	-	2.21/kg+22.2/ha	-		-		-	-	2.07/kg
2000/01	3.29/kg+NA	2.38/kg+79.1/ha	-	2.34/kg+22.2/ha	-	2.71/kg+101.3/ha	-		-	-	2.14/kg
2001/02	3.53/kg+NA	8.47/kg	-	4.23/kg	-	10.3/kg	-		-	-	2.29/kg
2002/03	3.57/kg+NA	8.71/kg	-	4.65/kg	-	10.76/kg	-		-	-	2.78/kg
2003/04	3.75/kg+NA	9.11/kg		5.42/kg	-	11.71/kg	-		-	-	2.98/kg
2004/05		0.87/1,000 seeds	1.01/1,000 seeds	0.63/1,000 seeds	-	1.26/1,000 seeds	-	1.41/1,000 seeds	-	0.56/1,000 seeds	0.30/1,000 seeds
2005/06		NA+0.57/1,000 sd		0.95/1,000 seeds	-	1.39/1,000 seeds	-	1.61/1,000 seeds	-	0.62/1,000 seeds	0.19/1,000 seeds
2006/07		0.28/1,000 sd+NA		0.99/1,000 seeds	1.25/1,000 seeds	1.53/1,000 seeds		NA	NA+1.38/1,000 seeds	0.62/1,000 seeds	0.18/1,000 seeds
2007/08		NA+0.28/1,000 seeds		0.98/1,000 seeds	1.27/1,000 seeds	1.55/1,000 seeds		NA	1.88/1,000 seeds	0.62/1,000 seeds	0.39/1,000 seeds
2008/09		NA		1.1/1,000 seeds	1.36/1,000 seeds	1.53/1,000 seeds	0.51/1,000 sd+NA	NA	1.9/1,000 seeds	0.62/1,000 seeds	NA

Notes:

1. Wherever there are two numbers in a cell, the first is the price of seed and second is the technology fee. One number denotes seed price+technology fee.
2. 2001/02 - maximum technology fee/ha for Bt = US$79.1, BtRR = $101.3, RR = $22.2
3. 2002/03 - maximum technology fee/ha for Bt = US$79.1, BtRR = $101.3, RR = $25.95
4. 2003/04 - maximum technology fee/ha for Bt = US$79.1, BtRR = $101.3, RR = $25.95
5. 2004/05 - maximum technology fee/ha for Bt = US$79.1, BG II =$98.8, BtRR = $106.3, BGIIRR = $126.1, RR = $35.8
6. 2005/06 - maximum technology fee/ha for Bt = US$49.4, BtRR = $121.1, BGIIRR = $135.9, RR = $69.2
7. 2006/07 - maximum technology fee/ha for Bt = US$48.2, BtRR = $121.1, BGIIRR = $138.4, RR = $71.7, RRF = $98.8, BGIIRRF = $158.1
8. 2007/08 - maximum technology fee/ha for Bt = US$48.2, BtRR = $121.1, BGIIRR = $138.4, RR = $71.7, RRF = $98.8, BGIIRRF = $158.1
9. 2008/09 - maximum technology fee/ha for Bt = US$48.2, BtRR = $121.1, BGIIRR = $138.4, RR = $71.7, RRF = $98.8, BGIIRRF = $158.1

Source: John Black, Department of Agricultural Economics, Mississippi State University, MS, USA

mean that it will commercialize biotech cotton. There have been cases where the opposite has also happened. The reasons for such a reversal can be many, but the fact is that there are some countries, such as Zimbabwe, that have their biosafety legislation in place and have completed the testing, but have not commercialized biotech cotton.

Who Reaps the Benefits?

The technology has economic benefits, but that is not the focus of this article. Benefits tend to vary greatly among growers and countries. The three primary beneficiaries of biotech cotton are: a) the technology developers (Monsanto, Dow AgroSciences, Bayer CropScience, etc); b) the seed companies (in various countries that sell biotech genes through their varieties) and c) the growers. Benefits also trickle down to consumers, but only a small proportion of the economic advantage. However, no matter how many benefits there may be along the chain, the broad-spectrum benefit, the one that is most sustainable and uniform in regard to production practices, is the elimination of multiple applications of insecticides.

References

Traxler Greg, Salvador Godoy-Avila, José Falck-Zepeda, and José deJesús Espinoza-Arellano. 2000. Transgenic Cotton in Mexico: Economic and Environmental Impacts. Available at http://infoagro.net/shared/docs/a2/Traxler.pdf.