Bt cotton adoption and variety market development:

The Chinese case

Naiyin XU (naiyin@126.com)

Michel FOK (michel.fok@cirad.fr)

The point

- Is original
  - Large adoption of Bt cotton thanks to variety market development
  - …but messy market development is endangering the Bt cotton use
- Not valid everywhere, but…
  - …possibly relevant in other countries (India?, later on Pakistan?)

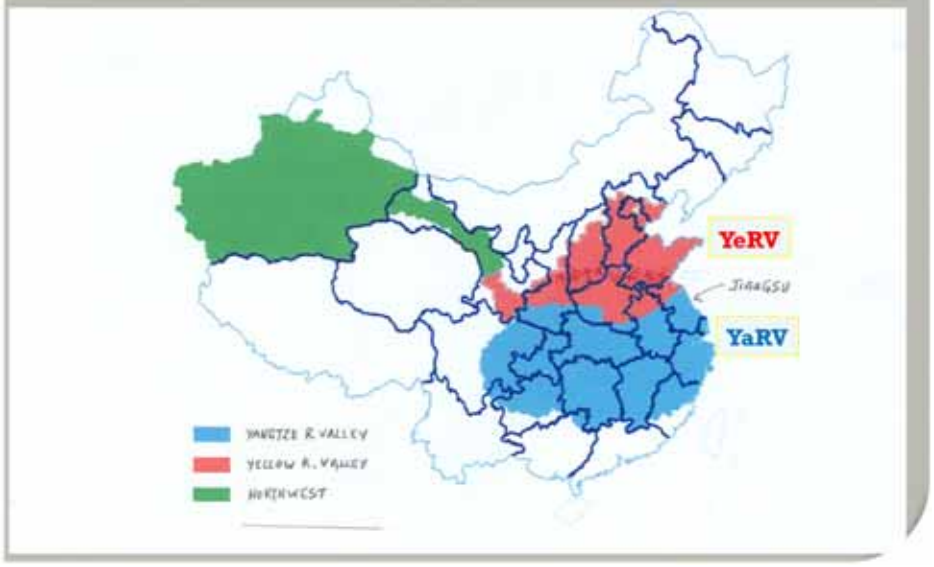
Various data sources used

- 3 data sets seldom exploited
  - Area data of the National Centre of Extension
  - Data of the Yangtze River Valley multi-location varietal experiment network
  - Data of the National Service for registration of varieties
- Specific surveys of two projects of mine

Presentation sequence

- Chinese cotton specificities
- Bt: factor of cotton revival?
- Widespread adoption of Bt cotton
- Features of variety market development
- Non-sustainability of variety market
- Debatable attemps for market regulation

Cotton zones in China



Tiny cotton farms , lot of varieties used

	2006	2007	2008	2009
Nber producers	119	207	338	173
Average cotton area per farmer, ha	0.66	0.48	0.39	0.36
Nber varieties recorded	50	67	113	59

Notes: figures based on varieties with verified names

Small cotton farming

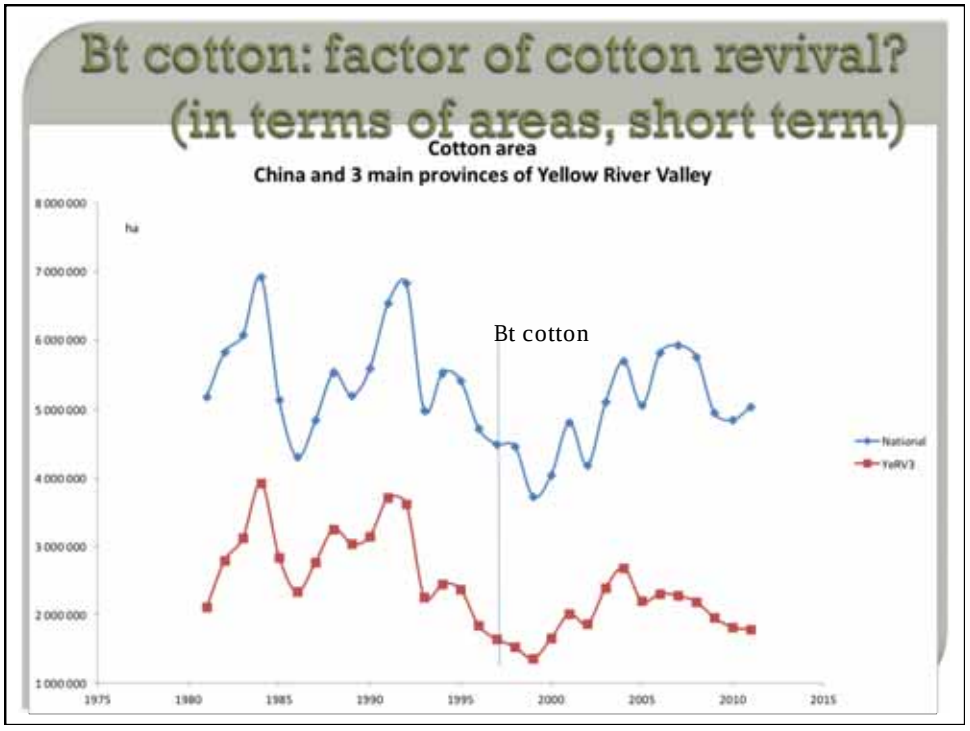
213 distinct varieties in 4 years

In 2009, only 9 out of 59 varieties were used 2 or 3 years earlier

Source : Wang & Fok, 2011

6


Cotton transplanting in YaRV

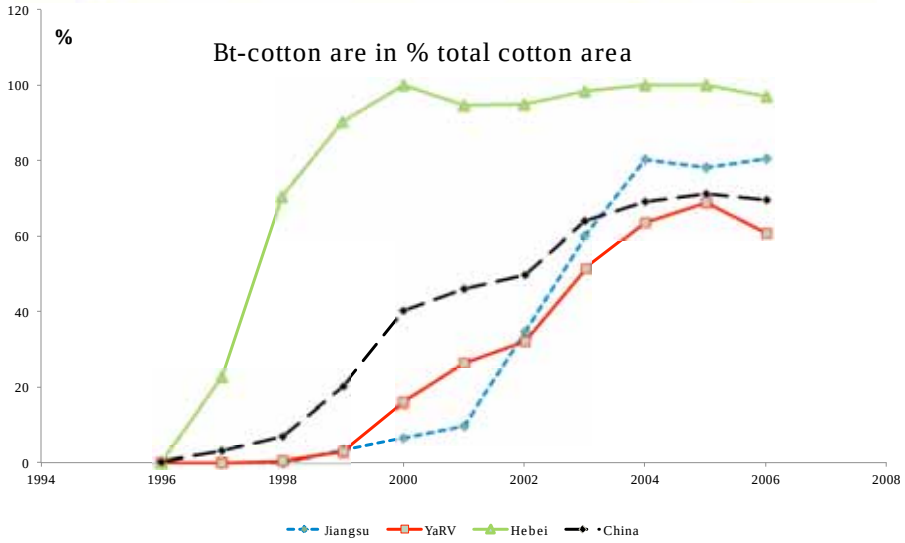

Bt cotton: factor of cotton revival?
(in terms of areas, short term)
Cotton area
China and 3 main provinces of Yellow River Valley
ha
8 000 000
7 000 000
6 000 000
5 000 000
4 000 000
3 000 000
2 000 000
1 000 000
1975
1980
1985
1990
1995
2000
2005
2010
2015
Bt cotton
National
YaRV3

Bt cotton: factor of cotton revival? (not in terms of yield)

Widespread adoption with important share of hybrid varieties

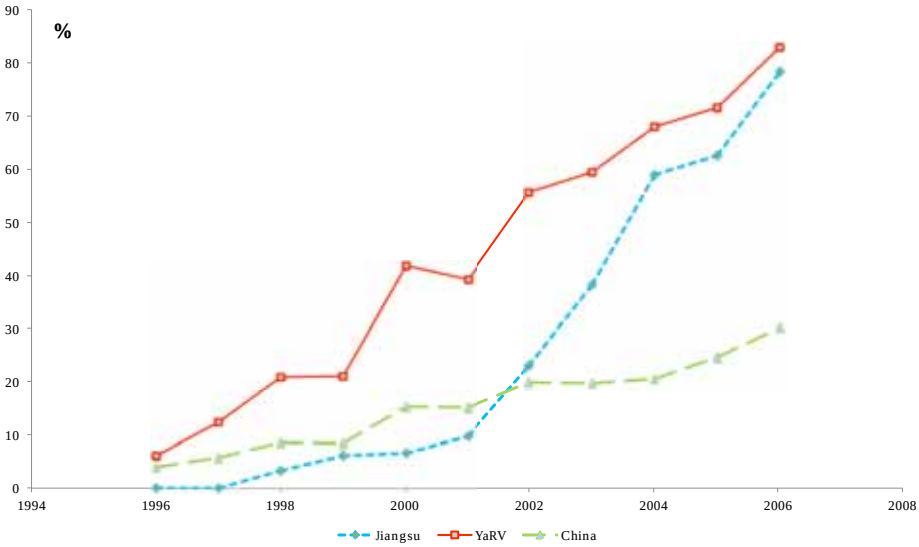
- Large diffusion of Bt cotton in various regions
- Specifity of YaRV in large adoption of hybrid varieties
- Very frequent combination of hybrid and Bt traits

Important albeit variable Bt-share



Data source: National Centre of Extension

Shares of hybrids in total cotton areas



Data source: National Centre of Extension

Reasons of Bt adoption

- Specific advantages of Bt?
  - Limited impact now
- More impact of variety market development

Limited yield gain from Bt trait

		Seedcotton yield kg/ ha
Hyb & Bt	Average (std dev)	4392 (699)
	Number data	140
Non-Hyb & Bt	Average (std dev)	3234 (440)
	Number data	28
Hyb & non-Bt	Average (std dev)	
	Number data	
Non-Hyb & non-Bt	Average (std dev)	3459 (419)
	Number data	5

Data source: our survey, Jiangsu 2005

Seeds cost more for hybrid trait

		Seed cost US$/ha
Hyb & Bt	Average (std dev)	98.6 (21.7)
	Number data	109
Non-Hyb & Bt	Average (std dev)	6.9 (1.6)
	Number data	10
Hyb & non-Bt	Average (std dev)	84.5 (10.4)
	Number data	3
Non-Hyb & non-Bt	Average (std dev)	7.7 (0.5)
	Number data	4

Data source: our survey, Jiangsu 2005

Limited reduction in sprays by Bt

		Number insecticide sprays
Hyb & Bt	Average (std dev)	12.4 (4.4)
	Number data	77
Non-Hyb & Bt	Average (std dev)	
	Number data	
Hyb & non-Bt	Average (std dev)	16.7 (5.8)
	Number data	3
Non-Hyb & non-Bt	Average (std dev)	
	Number data	

Data source: our survey, Jiangsu 2005

Limited cost reduction by Bt

		Insecticide cost US$/ ha
Hyb & Bt	Average (std dev)	85.0 (33.5)
	Number data	77
Non-Hyb & Bt	Average (std dev)	
	Number data	
Hyb & non-Bt	Average (std dev)	141.9 (51.7)
	Number data	3
Non-Hyb & non-Bt	Average (std dev)	
	Number data	

Data source: our survey, Jiangsu 2005

Limited income gain from Bt trait

		Gross income US$/ha
Hyb & Bt	Average (std dev)	2329 (286)
	Number data	140
Non-Hyb & Bt	Average (std dev)	1600 (286)
	Number data	28
Hyb & non-Bt	Average (std dev)	
	Number data	
Non-Hyb & non-Bt	Average (std dev)	1671 (286)
	Number data	5

Data source: our survey, Jiangsu 2005

Effective variety & seed market development

- Favorable institutional framework since year 2000
  - Financial incentives to breeders
- Bt cotton release: factor of seed market modernisation
- Hybrids increased competition
  - Easy and quick to create new varieties
  - Turned around farmers' habit of not renewing seeds yearly

Active offer of varieties

Period	No. Varieties with areas recorded by Nat. Centre of extension
1990-1999	199
2000-2006	372

Number of breeding organisations having submitted varieties for national registration; 1999-2007

HQ at	Firms	Coll/Univ	Research Institutes	Ag. Services	Total
Counties	9	1	11	1	22
Districts	35	1	31	1	68
Provinces	17	11	26	3	57
Central	2	1	6		9
Total	63	14	74	5	156

Data source: National service of variety registration

Conquering national market

	No. Varieties submitted	Share of No. Varieties submitted for national registration in total (%)	
		hybrid cultivars	Bt cultivars
1999	9	33.3	0.0
2000	27	44.4	44.4
2001	55	29.1	27.3
2002	72	27.8	48.6
2003	76	32.9	71.1
2004	73	32.9	71.2
2005	94	55.3	75.5
2006	115	62.6	87.0
2007	113	58.4	85.8
Total	634	45.7	68.8

Undesired effects of unregulated market development

- Competition could
  - become less/non profitable
  - lead to paradoxical high prices of seeds
  - Attract more fake products
  - Induce perception of less Bt-effectiveness
  - Push farmers to adapt to market mess
    - Exacerbating variety turn-over and competition
    - Moving back to non-Bt varieties

More varieties, less area each

Provinces	1990-1999 No. Varieties	1990-1999 Mean area per variety & per year	2000-2006 No. Varieties	2000-2006 Mean area per variety & per year
Anhui	83	3 567	144	2 185
Shandong	132	6 010	146	5 245
Xinjiang	109	5 612	190	4 491
Jiangsu	86	5 323	117	2 441
Hebei	117	4 226	76	6 940
Henan	150	5 949	233	3 133
Hubei	81	4 955	116	2 618
Hunan	37	3 688	75	1 637

Seed prices are increasing

	NH-NBt	H-NBt	NH-Bt	H-Bt
1996		16		
1998		24		
1999			9	
2001	8		37	30
2002			28	40
2003	3		37	45
2004	8			90
2005	4			96
2006				103
2007	5	80	30	120

Market full of non-registered varieties

	2006	2007	2008	2009	All years
	Shares of total variety numbers				
variety with correct names	68.0	65.7	39.8	69.5	56.7
varieties with doubtful names	32.0	32.8	59.3	30.5	42.6

In terms of areas occupied, doubtful varieties represented 25%

25

High level of unhappiness with seeds

…both with regard to price and quality

% farms unhappy with seed price	62.3
% farms unhappy with seed quality	43.3

26

Bt advantage less perceived

Less positive perception of Bt cotton

Farms…	% of all farms
unhappy with Bt-cotton effect	36.1
finding that profit was somehow disappointing	39.4
finding that Bt effect has decreased	31.0
finding that Bt profit has decreased	28.9

Although hard to distinguish underlying reasons
* seeds are not Bt indeed, or not sufficiently
* pest complex has shifted out of the scope of effectiveness of BT

Distribution of farms according to their perception of Bt varieties (% total number of farms)

27

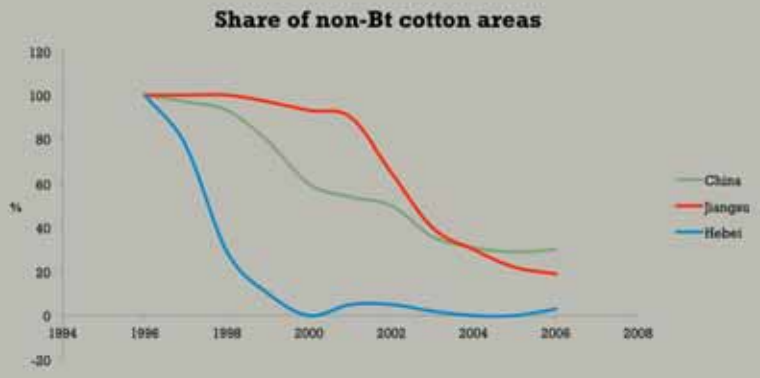
Adaptation to market mess

using multiple varieties…even on tiny farms

	2006	2007	2008	2009	All years
Number of varieties by producer	1.8	1.6	1.5	1.5	1.5
% producers with one variety	46.2	48.3	61.8	68.8	57.7
% producers with two varieties	34.5	45.9	31.7	17.9	32.7
% producers with 3 or more varieties	19.3	5.8	6.5	13.3	9.6

28

Stagnation of Bt adoption?



Move back to non-Bt?

	All years
Only one variety on farms	
Number of farms	349
% of farms where variety is of Bt type	83.7
% of farms where variety is of non-Bt type	16.3
More than one variety on farms	
Number of farms	328
% of farms where varieties are of only Bt type	69.8
% of farms where varieties are of only non-Bt type	7.3
% of farms where varieties are of both types	22.9

30

Ineffective attempt to regulate market

- Quality seed subsidy Policy (2007-2010)
- More barriers to organisations to enter the variety and seed market

Conclusion

- Issue dealt with
  - = sustainability of transgenic cotton use
- Already debated threat to sustainability
  - Linked to various shifts of ecological systems
    - Resistant weeds to glyphosate
    - Secondary pests becoming nightmares
- Other threats to sustainbility
  - Market structure
    - Requirement for monitoring and regulation
      - Not esay

For more information

- Papers of reference
  - **Fok, M., & Xu, N. (2011)**. Variety Market Development: A Bt Cotton Cropping Factor and Constraint in China. *AgBioForum*, *14*(2), 47–60.
  - **Wang, G., & Fok, M. (2011)**. Status and factors of transgenic cotton coexistence in Hebei Province (China). *GMCC11, Coexistence 2.0: Achieving Coexistence of Biotech, Conventional & Organic Foods in the Marketplace*. Vancouver, Canada.
  - **Fok, M., & Xu, N. (2010)**. Intégration technologique et développement du secteur semencier: deux facteurs de la diffusion du coton-Bt dans Vallée du Fleuve Yangtze (Chine). *Economie Rurale*, (317), 40–56.
  - **Xu, N., Fok, M., Bai, L., & Zhou, Z. (2008)**. Effectiveness and chemical pest control of Bt-cotton in the Yangtze River Valley , China. *Crop Protection*, *27*, 1269– 1276.