Mirid bugs in China: pest status and management strategies

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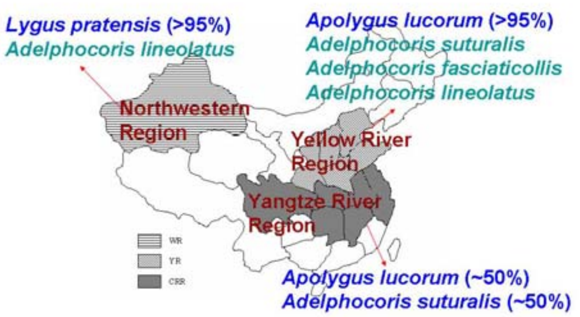
Species composition

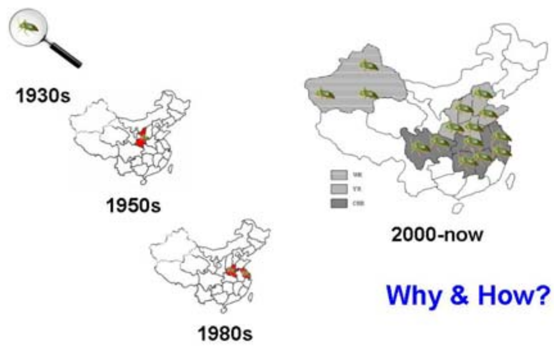
In China, > 20 species of mirid bugs were recorded in cotton fields. These above five species are the major ones.

Geographical distribution



In different cotton-planting regions, Species composition of mirid bugs is greatly different. In Yangtze River Region, *Apolygus lucorum* and *Adelphocoris suturalis* are two major ones with the similar population levels. In Yellow River Region, the *A. lucorum* is the dominant one with more than 95% population of all the mirid bugs. In northwestern Region, the *Lygus pratensis* is the major one.

Pest status evolution

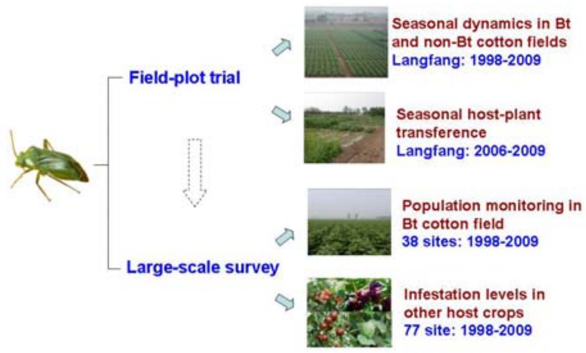


Mirid bug damage in cotton was firstly recorded in early 1930s in China. During the next 70 years, mirid bugs were always a group of secondary insect pests with low infestation levels. From 2000, population levels of mirid bugs greatly increased in three major cotton planting regions. During the last 15 years, we conducted the study on two topics. The first one is why the damage of mirid bugs greatly increased, and the second is how to manage this new problem.

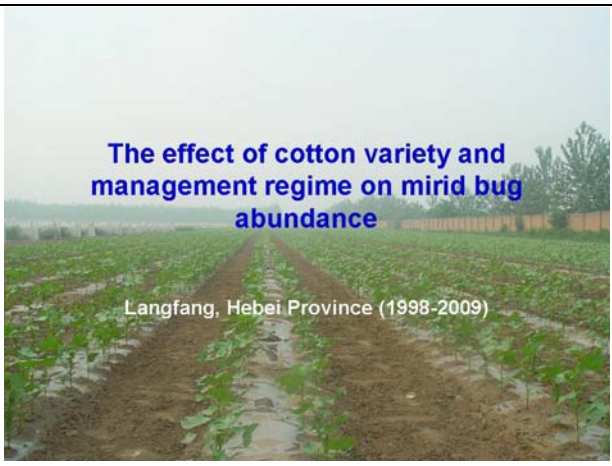
Part one

Why did the infestation levels of mirid bugs greatly increase?

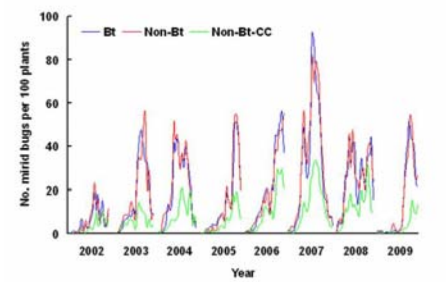
Part one, why did the infestation levels of mirid bugs greatly increase in China?



We conducted several trials from 1998.

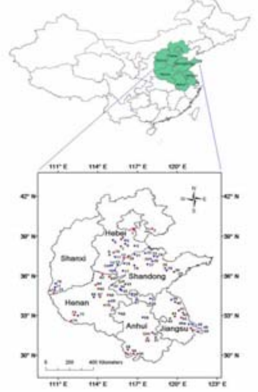


The first one is the effect of cotton variety and management regime on mirid bug abundance. This trial was conducted in our Langfang experimental station.



Mirid bug population dynamics in Bt and non-Bt cotton with different management regimes from 2002-2009. "Bt" and "Non-Bt" respectively indicate Bt cotton and non-Bt cotton without insecticide sprays, while "Non-Bt-CC" represents non-Bt cotton with cotton bollworm, *H. armigera* insecticide sprays.

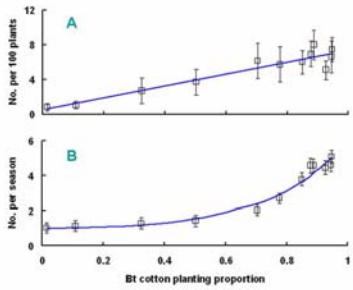
We found population density of mirid bugs was not significantly different between Bt cotton and non-Bt cotton without insecticide use. But in insecticide-treated plots for cotton bollworm control, mirid bug population significantly decreased. It indicated that insecticide use of cotton bollworm could also suppress the mirid bug population.



Multivariable assessment of mirid bug outbreak determinants

38 locations (●) in 6 provinces (1997-2008)

The second trial is large-scale monitoring of mirid bugs in the northern China.



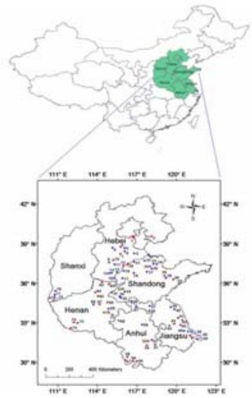
Association between mirid bug population density (A) or number of mirid bug insecticide sprays (B) and Bt cotton planting proportion in northern China during 1997-2008. Linear model for population density, y= 6.81x + 0.54, *P*<0.0001. Non-linear model for number of mirid bug insecticide sprays, y = 0.89 + 0.08*exp(4.21x), *P*<0.0001.

The results showed that with the increasing Bt cotton planting proportion, mirid bug population density and number of mirid bug insecticide sprays greatly increased.

Multivariate assessment of determinants of mirid bug population density and insecticide spray frequency in northern China during 1997-2008. For stepwise regression, only variables with significance *P*<0.05 were entered into the analysis. † "other insecticide sprays" target insect pests different from *H. armigera* or mirid bugs. RC, regression coefficient. R2, coefficient of determination. / shows no analysis.

Parameters	Mirid bug population density						Number of mirid bug insecticide sprays					
	Single regression			Stepwise regression			Single regression			Stepwise regression		
	RC	R^2	*P*	RC	R^2	*P*	RC	R^2	*P*	RC	R^2	*P*
Total number of insecticide sprays	-0.2093	0.51	0.0095				/		/	/		/
Number of *H. armigera* insecticide sprays	-0.1079	0.87	<0.0001	-0.1079	0.87	<0.0001	-0.7214	0.84	<0.0001	-0.7214	0.84	<0.0001
Number of other insecticide sprays †	+0.1361	0.01	0.7131				-1.8505	0.06	0.4570			
Temperature	-0.0921	0.04	0.5242				-0.4116	0.02	0.6773			
Rainfall	-0.0001	<0.01	0.8956				-0.0005	<0.01	0.9487			

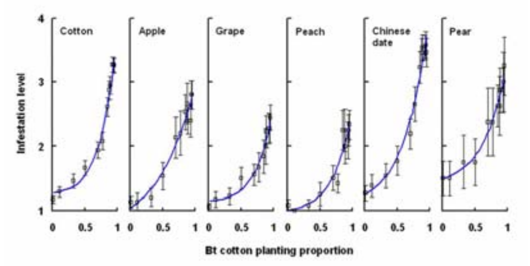
Regression analysis showed that the increasing mirid bug population density and number of mirid bug insecticide sprays were negatively correlated with the decreasing insecticide use for cotton bollworm. It means that the decreasing insecticide use for cotton bollworm led to the outbreak of mirid bugs in cotton.



Mirid bug infestation on alternative host crops

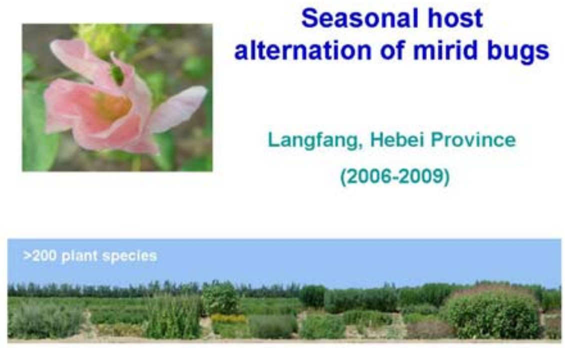
77 locations (●&●) in 6 provinces (1997-2008)

The third trial is large-area monitoring of mirid bug infestation on different host crops in cotton-planting region in northern China.

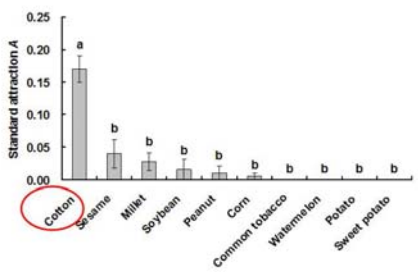


Association between mirid bug infestation levels in either cotton or key fruit crops, and Bt cotton planting proportion. The measure of mirid bug infestation was assigned a score ranging from 1 (no infestation) to 5 (extreme infestation). Non-linear model cotton, y = a + b*exp(c*x)

The results showed that with the area-wide planting of Bt cotton, the infestation levels of mirid bugs increased not only in cotton, but also in fruit tree crops.

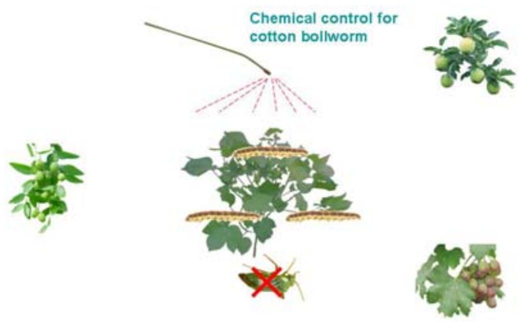


The forth trial is the seasonal host alternation of mirid bugs.



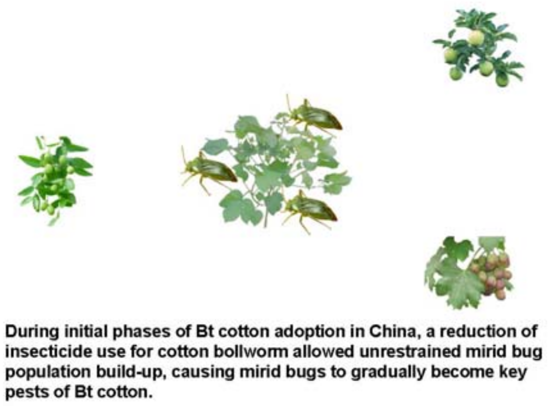
Different standard attraction of important summer crops for mirid bugs in mid-to-late June. Means (± SE) followed by the same letter are not significantly different by Tukey's HSD (P>0.05).

We found mirid bug adults have great preference to host plants at flowering stages. In middle June, cotton is the only agricultural crop entering into flowering stage in northern China. So the mirid bugs largely move into cotton fields from early-season host plants. This finding can explain why the damage of mirid bugs greatly increased in the whole agro-ecosystem.

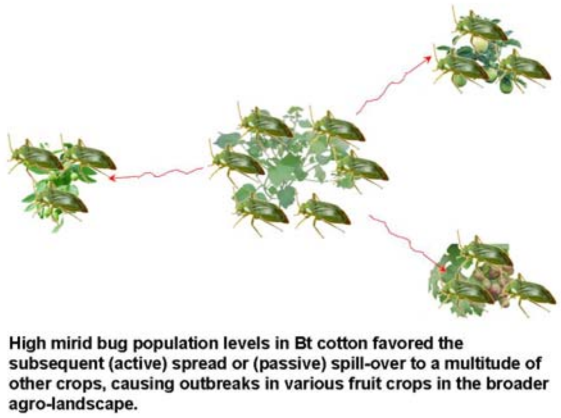


Prior to Bt cotton adoption, broad-spectrum insecticide use (against cotton bollworm) knocked down early mirid bug populations, with cotton acting as a dead-end trap crop for this pest.

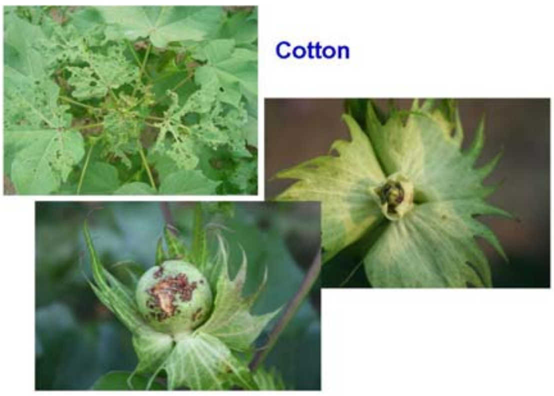
In mid-to-late June, mirid bug adults greatly prefer cotton over other host crops, readily move to cotton and subsequently build up their populations in cotton fields. Prior to Bt cotton adoption, broad-spectrum insecticide use (against cotton bollworm) knocked down early mirid bug populations, with cotton acting as a dead-end trap crop for this pest.



During initial phases of Bt cotton adoption in China, a reduction of insecticide use for cotton bollworm allowed unrestrained mirid bug population build-up, causing mirid bugs to gradually become key pests of Bt cotton.



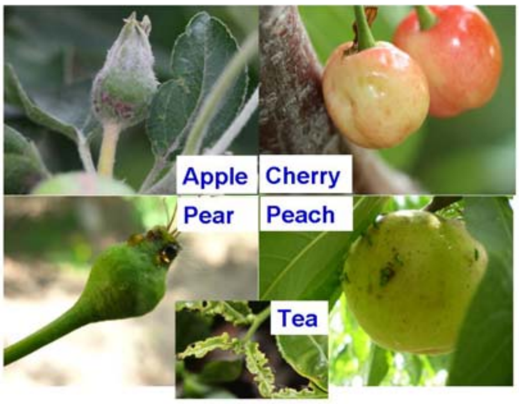
High mirid bug population levels in Bt cotton favored the subsequent (active) spread or (passive) spill-over to a multitude of other crops, causing outbreaks in various fruit crops in the broader agro-landscape.



This damage symptom of the mirid bugs on cotton leaves and bells.

Mirid bugs feed on the tender leaf and branch of Chinese date.

They damage on grape.



They also damage on apple, cherry, pear, peach and tea.

Part two

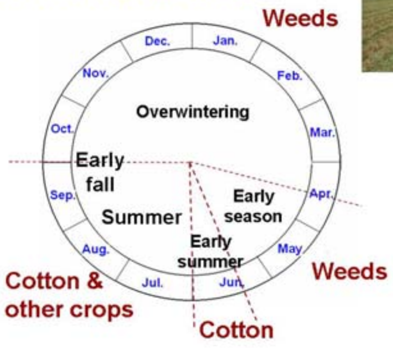
How to manage these new pests in the whole agro-ecosystem?

Part two is how to manage these new pests in the whole agro-ecosystem?

Major cropping patterns

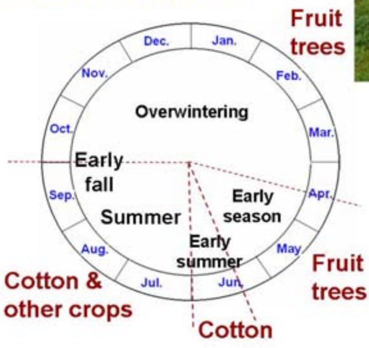
In northern China, there is small-farming cropping pattern. Each field is small, and different farmers grow different crops. There are three major cropping patterns in cotton-planting regions.

Mixed planting of cotton & grain crops



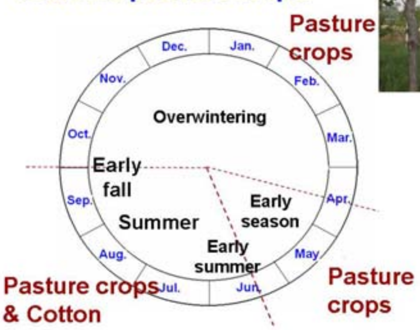
In mixed planting of cotton and grain crops, weeds are the major overwintering and early-season host plants. Cotton is the major one in summer. Hence, in winter and spring season, we control the mirid bugs in weed, and control it in cotton in summer season.

Mixed planting of cotton & fruit trees



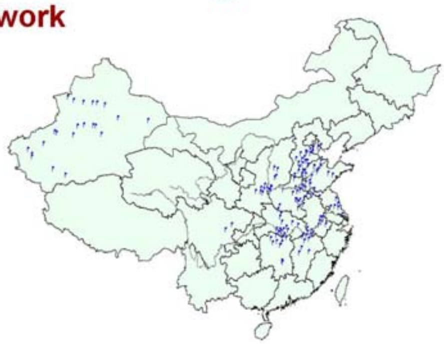
In mixed planting of cotton and fruit trees, fruit trees are the major overwintering and early-season host plants. Hence, in winter and spring season, we control the mirid bugs in fruit trees.

Mixed planting of cotton & pasture crops



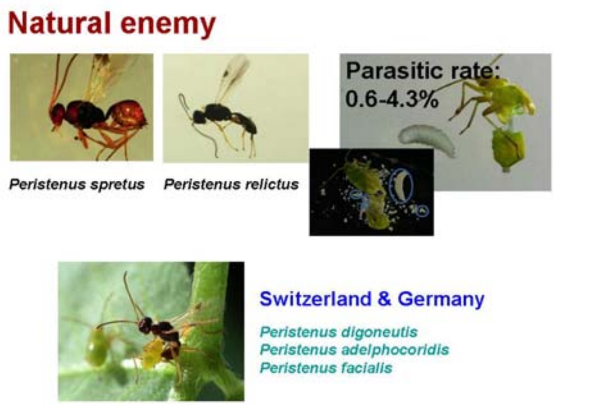
In mixed planting of cotton and pasture crops, pasture crops are the major host plants in the whole year. Hence, control of the mirid bugs in pasture crops is the most important.

National monitoring network

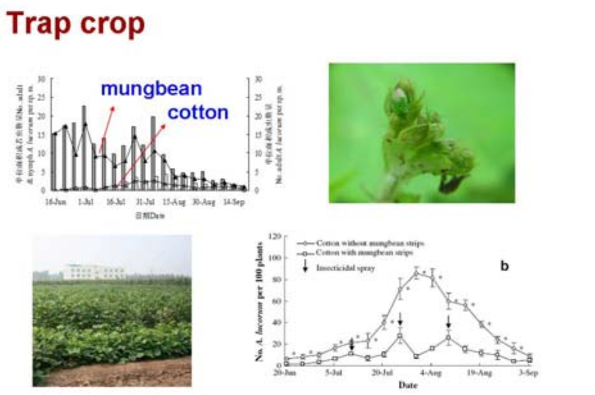


Base on the existed national monitoring network on cotton insect pest, Chinese government developed the monitoring network for mirid bugs.

Apolygus lucorum like to lay eggs and overwinters in cutting part of the branches of fruit trees. So winter and spring pruning can greatly lower the overwintering population. Removal of weeds around the cotton fields in winter and spring can reduce the overwintering and early-season population of mirid bugs.



For natural enemy, we found two species of parasitic wasps in China. But the natural parasitic rate is lower than 5 percent in cotton, weed, and alfalfa. This year, we introduced three species of parasitoids from Switzerland and Germany with the help of CABI (Centre Agriculture Bioscience International).



We found mungbean was a preferred host plant of Apolygus. Interplanting mungbean in cotton fields and combinating the insecticide use in mungbean stripe can reduce the population level of *Apolygus lucorum* in cotton fields.

We also developed sex pheromone for *Apolygus lucorum*.

Plant-derived pesticides

Matrine

Azadirachtin

We selected some plant-derived pesticides for control of mirid bugs. They are widely used in tea and fruit trees.

Chemical control

Butylene Fipronil
Bifenthrin
Methomyl
Malathion
Chlorpyrifos
Endosulfan
Imidacloprid

We also selected some effective chemical insecticide.

Thanks!