



Transgenic Cry1Ac+CpTI cotton cultivar may carry an antifeedant effect on the honey bee *Apis mellifera*



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Introduction

Overall in China, there is a marked decrease in regional outbreaks of various pests in cotton crops associated with the planting of Bt cotton (Wu et al. 2008). Planting area of the transgenic Cry1Ac+CpTI cotton cultivar (CCRI41) has covered 50% of the total area in Yellow river cotton zone in northern China. In the same area, the honey bee *Apis mellifera* L. (Hymenoptera, Apidae) is the main pollinator for most crops and thus there are concerns about potential side effects that may have these transgenic crops on bee's health.



The pollen containing insecticidal proteins Cry1Ac and CpTI may affect survival and feeding behavior of the honeybee since some preliminary studies have been carried out about the risk assessment Of GM crops on honey bees (Ramirez-Romero et al. 2008), which demonstrated that the feeding behavior was affected when exposed to the artificial diet containing relative high doses of Bt toxins.

Aims of the study

- Quantify the doses of Cry1Ac and CpTI in fresh Bt pollens.
- Assess the potential effect of a transgenic Cry1Ac+CpTI cotton cultivar pollen on:

- (1) mean mortality of bees during oral sub-chronic exposure to the pollen.
- (2) potential subsequent sublethal effects on feeding behavior of bees.

Methods

- We used EnvironLogix ELISA Kits to quantify the amount of the toxin Cry1Ac and ELISA polyclonal Kits for testing the CpTI toxin in the this pollen.
- Oral sub-chronic exposure of bees to Bt cotton was undergone as follow: mixing water, honey, and Bt pollen at a proportion at 1:2:7. Imidacloprid at 48ppb was used as positive control, and pollens from conventional cotton as control.
- Bee mortality and consumption of pollens were recorded daily during a 7-day oral subchronic exposure period.



Rearing the bees

ELISA for detecting Cry1Ac

Results

- A much higher dose of the Cry1Ac in transgenic Cry1Ac+CpTI cotton pollen was obtained in our study than those reported by Biao et al. (2009).

	June 20	July 20	August 20
Cry1Ac	158.0± 7.35	300.0± 4.52	32.8± 3.39
CpTI	*	*	*

* detectable quantity but very low level.

Table 1. Contents of toxins in transgenic pollen. ng/g (±SD).

- Exposure of honey bees to Cry1Ac + CpTI pollen did not increase the mortality compared with the control.

Treatment	Mortality	Statistic
Control	13.8%	
Cry1Ac+CpTI	21.3% NS	$\chi^2 = 3.12$; $P = 0.078$
Imidacloprid	20.0% NS	$\chi^2 = 2.23$; $P = 0.136$

(NS : not significantly from the control.)

Table 2. Mean mortality in bees during exposure to the three different treatments.

- Cumulated consumption of Cry1Ac+CpTI pollen per bee was significantly lower than the control.

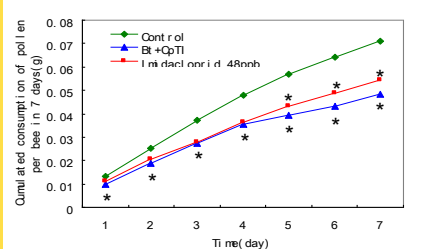


Fig 1. Cumulated consumption of pollen per bee during exposure to the three different treatments.

(p<0.05, * significantly different from the control)

Conclusion

- Transgenic Cry1Ac+CpTI cotton cultivar pollen carry no lethal risk for honey bees.
- It was concluded that this cotton cultivar pollen indicated a risk for potential antifeedant effect on honey bees.
- The high dose of insecticidal protein Cry1Ac may be the direct factor causing disruption of physiological function of mid-gut in honey bees.
- This antifeedant effect may cause malnutrition and thus harm the health and individual development of young adult honey bees. Such circumstances is unfavorable to the whole population development in honey bee combs.



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References

Kong-Ming Wu, Yan-Hui Lu, Jian-Zhou Zhao. 2008. Suppression of cotton Bollworm in multiple crops in China in areas with Bt toxin-containing cotton. *Science*. 321:1676-1678.

Ramirez-Romero R., Desneux N. Decourtye A., Chaffiol A., Pham-Delegue M.H. 2008. Does Cry1Ac protein affect learning performance of the honey bee *Apis mellifera* L. (Hymenoptera, Apidae)? *Ecotoxicology and Environmental Safety*. 70:327-333.

Biao Liu, Chang Shu, Kun Xue. 2009. The oral toxicity of the transgenic Cry1Ac+CpTI cotton pollen to honey bee *Apis mellifera*. *Ecotoxicology and Environmental Safety*. 72:1163-1169.