CSBV Silencer
Chinese Sacbrood Virus

FAFU-CHINA team
Fujian Agriculture and Forestry University
Fuzhou, CHINA
a beautiful, elegant, diligent being......

- Pollanitation
- Honey & foods
- Other products
Honeybees

All bees:

- Estimated 1/3 of food is pollination dependent
- Pollinate 70 types of crop
- Make 6,000 tonnes of honey
- Contribute £400 million to the economy

A colony:

- Pollinates 4,000 m² fruit trees
- Makes avg 14kg of honey
- Contains 50,000 bees

Reference: The British Beekeepers Association; Photo Courtesy of the BBC
CSBV: Chinese Sacbrood Virus

- 1970s, first appeared in Guangdong & Guangxi provinces
- Quick spread from eastern to western, to all China
- In the past 40 years, loss of >50% honeybee colonies
- 57% hives in southwestern China carry CSBV (2007 statistics)
Current treatments

TCMs

Chemicals
RNA interference

- Double-stranded RNA (dsRNA) is chopped into short interfering RNAs (siRNAs) by the enzyme Dicer.
- The RNA-induced silencing complex (RISC) enzyme attaches to siRNA.
- The siRNA-RISC complex attaches to target mRNA and chops the mRNA into small pieces.

Chopped mRNA (no longer functional)
Capsid proteins assemble RNA and release it to hosts’ cytoplasm. Non-structural proteins participate in the virus replication.
Target gene selection

CSBV's homologous dsRNA
1 dsGFP, 2 dsHelicase, 3 dsProtease, 4 dsRdRp, 5 dsVP1

The pupation rate of infected larvae
Test experiment

1. Transformation of L4440-RdRp into HT115
2. Induction of IPTG
3. Production of dsRdRp mRNA
4. Addition of Food
5. Feed for Healthy colony
Significant decrease of infected larvae
Significant increase of sealed broods

The graph shows the number of sealed broods before and after the application of the CSBV silencer. The data is categorized into Control, Low, Medium, and High levels. The legend indicates different time points: Before CSBV Silencer, 1 week later, 2 weeks later, and 3 weeks later. Statistically significant differences are marked with letters (a, b, c, etc.).
Modelling

Data fitting

\[ f(x) = \frac{a}{(1 + b \cdot 2.7^{-c \cdot x})} \]

Coefficients (with 95% confidence bounds)

- \( a = 0.3465 (0.3206, 0.3723) \)
- \( b = 49.63 (-79.79, 179) \)
- \( c = 1.76 (0.6333, 2.886) \)

When the concentration of IPTG is 0.5 mmol/L, the system reaches the steady state.
Hill equation

\[ f(x) = P_{\text{max}} \cdot \frac{X^n}{X^n + X_M^n} \]

Coefficients (with 95% confidence bounds)

\[ X_M = 0.1265 \ (0.08411, 0.1689) \]
\[ n = 2.239 \ (0.8187, 3.658) \]
Wider applications

Western honeybees

Termites

Fire ants
Interview

Prof. Songkun Su
- IPTG
- dsRNA

Beekeeper: Lei Shen
- Profit
- Livelihood
- Treatments
Apiculture
Fanshu Park (NGO)

- Bee knowledge
- Project design
Achievements

- Submitted RdRp (BBa-K1864000), T7 RNAP
- (BBa-K1864001) parts, and improved parameters of Gal promoter (BBa_K105026).
- CSBV Silencer 1.0 has been tested successfully and primarily applied in apiculture.
- Popularization of knowledge about Chinese honeybees, science education for children, training beekeepers for better dealing with CSBV.
Acknowledgements

Team members

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Welcome to Fujian Agriculture and Forestry University