Foundation for Sustainable Development to A Prosperous, Hormonius and Greener Asia

Genomics-based Comparative Analyses of Gene Expression of Wild Asian Honeybees for Improving Domestic Honeybees

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Beekeeping (=Apiculture)

Products

- **Honey**
- Wax
- Royal jelly
- Propolis

Pollination (estimated value:$15 billion/ year:in the case of USA)

Beekeeping (=Apiculture)

Low cost/High yield industry
From small scale family based industry
To large scale enterprise
Essential to Global Ecology

Beekeeping in Asian Countries

Plenty Bee plant (nectar source)
A long history of honey-hunting and traditional beekeeping

Suitable area for development of beekeeping

European Honeybee

(*Apis mellifera*)

Asian Honeybee

(*Apis cerana*)

European Honey Bee vs. Asian Honey Bee

- high productivity
- gentle
- susceptible to infectious disease
- susceptible to parasitic mites
- no escaping

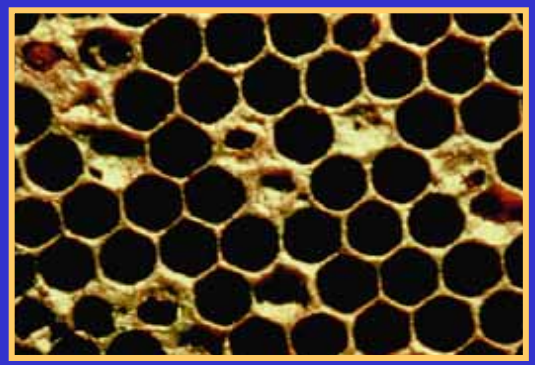
- low productivity
- very gentle
- tolerant to infectious disease
- resistance to parasitic mites
- often escaping

Diseases of Honeybees – American Foulbrood

(Paenibacillus larvae)

Normal healthy larvae

Infected brood (Pupa tongue)



Disease progression
(Pepper box symptom)

Definition field test

Parasitic Mite (*Varroa destructor*)

European Honey Bee vs. Asian Honey Bee

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Many favorable traits in Asian Honey bees

The idea:
To improve European Honey bee genetically using these information from traits of Asian Honey bees.

However
Two species are sexually isolated from each other.
They do not produce hybrid offspring.
The genetic information controlling these traits has been largely unknown.

Honey bee Genome Project is completed!

Exhaustive Gene Expression Analyses of Honey Bee genes

- Using sequence information of European Honey bees, picking genes up from Asian Honey Bees.
- Expression analyses of each gene
- Compare the gene expression in European and Asian Honey bees

Target Traits to improve

- Resistance to infectious disease (e.g. American foulbrood)
- Tolerant to parasitic mites
- Gentleness

Target Traits to improve

- Resistance to infectious disease (e.g. American foulbrood)
  - strengthen innate immunity
  - introduce cleaning behavior
- Tolerant to parasitic mites
  - introduce glooming behavior
- Gentleness
  - remove attacking behavior
  - protect from virus infection

Target Traits to improve

- Resistance to infectious disease (e.g. American foulbrood(AFB))
  - –innate immunity
- Tolerant to parasitic mites
- Gentleness

Our research strategies:

- To study internal defense mechanisms of Asian Honey Bees to bee pathogen, including the innate-immune response

- To obtain genes which their expression is significantly increased during infection of pathogen

- To apply the discovered data of innate immune-response in Asian Honey Bees to improve the tolerance capacity of the AFB disease in European Honey Bees