2010 Cranberry Management Update: Molecular Detection of Parasites in Bumblebees

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Commercial Pollinators

Updates on bumble bees, migratory honey bees, and CCD

Highlights of CCD research findings

- Heavy focus on:
  - Varroa mite,
  - Pesticides,
  - Queen breeding – resistant strains of honey bees

- Debate over whether migratory bees are less healthy than stationary bees
  - Some work to show negative physiological effects, but may not translate into economic difference
  - Pathogens and parasites are problematic, but not consistently
  - Hard to say whether renters will be economically impacted this year.
RNA interference (RNAi)

• New technology to change the world
  • Very safe method for disease control
  • Highly specific

• Method
  • Gene specific, naturally occurring materials that can be fed to bees to inhibit gene expression of parasites and pathogens

• New Market
  – First use to be approved by FDA
  – Beeologics has several products to improve pollinator health
    • Viruses
    • Nosema
    • Varroa mite

Bumble bees

• Bumblebees pollinate about 15% of our food crops (valued at $3 billion)
• Close to 50 species in US and Canada
• Commercial rearing was on the rise in the early 1990’s
Initiative to regulate bumble bee importation

• Professor Emeritus Robbin Thorp, an entomologist at UC Davis
• Monitored bumble bee populations
  — Found that two species disappeared
• Hypothesized that commercial rearing had something to do with it

• 1997: Koppert had outbreak of *Nosema bombi* that wiped out west coast commercial bumble bee stock
  — Biobest suffers also
• USDA Animal Plant Health Inspection Service (APHIS) allowed queens to be shipped to Europe for domestication from 1992-1994
  — Queens were reared alongside a common European species
• Thorp believes North American species acquired an exotic strain of *Nosema bombi* at this time.
Bumble bee decline

• The bumble bee species that suddenly became rare all belong to the same sub-genus.
  – Used as evidence to suggest that pathogen introduction was cause of decline
    • Purely circumstantial
    • No evidence to show that pathogens in populations of wild bees are the same strains as recovered from Europe
    • Pathogen outbreak in rearing facilities could have been from native queens used for interbreeding

Managed Pollinator CAP (Coordinated Agricultural Project)
A National Research and Extension Initiative to Reverse Pollinator Decline

• Molecular techniques
  – Pathogen detection (PCR)
  – DNA sequence comparison
  – Possible transmission patterns
    • Important to look at more than 1 gene

• Stationary Apiary
• Pesticides
Our Hypothesis

- Techniques currently used don’t detect differences between populations so transmission patterns can’t be discerned.
- We can create tools that provide us with the right data to answer some of those questions
- Same approach can be applied to many pathogens and parasites including:
  - *Nosema bombi*
  - *Crithidia bombi*
  - Tracheal mite
  - Viruses

Methods

- Sampling
- Sample preparation
- Nucleotide purification
- PCR
- Sequencing
Collections

- 2008
- 2009
- Stationary Apiary
  - Honey bee pathogens can potentially infect bumble bees that forage in the same location
- Biobest
- Koppert

2008 Highlights

*Crichidia bombi*
2009 Highlights

• Made protocol for detecting tracheal mite
• Detected in Koppert bees
• Very rarely detected in wild collected bees
  – Except near where commercial bees are potentially used

• *Nosema* only found at 7 of 35 sites tested
• *Crithidia* found at 20 of 35 sites tested
• Koppert
  • *Nosema bombi*
  • Tracheal mite
  • DWV
• Biobest
  – *Crithidia bombi*
Stationary Apiary

- **Minnesota (98 bees)**
  - No *Crithidia bombi*
  - No tracheal mite
  - Only one bee with *Nosema bombi*
    - Only bee of that species in the collection
  - # of bees positive for DWV

Stationary Apiary

- **Maine (37 bees)**
  - 23 of 37 have *Crithidia bombi*
    - 7 of 9 species of bumble bees represented
  - No tracheal mite
  - No *Nosema bombi*
  - No bees positive for DWV
  - 9 different species of bumble bee including 2 very rare species
  - No commercial bumble bees used in the area for approximately 15 years
Invasive bumble bees

- Enter ecosystems and compete with native bees (larger and disease resistant)
  - Direct competition
    - Nesting sites
    - Food resources
    - Mates
    - Reproduction – socially parasitic workers
  - Reproductive disturbance
    - Commercial colonies can reproduce earlier in the season, males try and mate with whatever queens they can find

Bumble bees like:

- Nesting sites:
  - Piles of debris
    - Mulch, rocks, old containers
  - Abandoned rodent homes
  - Flowers (common weeds) when crops aren’t flowering
    - Dandelions
    - Goldenrod
    - Clover