Current State of Honey Bees

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Main Topics Covered

- **Honey Bees 101**
- **CCD (Colony Collapse Disorder)**
- **Stresses on Honey Bee Colonies**
- **Pesticides and Honey Bees**
- **Protecting Honey Bees**

Honey Bees 101

- **Honey bee colonies are supposed to be perennial**
- **Honey bees do not hibernate**
  - **They keep themselves alive and active over winter**
- **Usually one queen persists for more than a year**
  - **Currently, not the case for many beekeepers**
    - **Some beekeepers are requeening twice a year**

Queen and Retinue

Honey Bees 101 (cont.)

- During the winter the queen lays few to no eggs
- During early spring, the queen lays around 2,000 eggs per day
  - "Nurse bees" feed her and remove her waste products
- During summer and fall, the queen lays closer to 1,000 eggs per day

Honey Bees 101 (cont.)

- **Eggs hatch in three days**
  - **Female larvae from fertilized eggs**
  - **Male (drone) larvae from unfertilized eggs (larger cell size)**
- **Female larvae can become either queens or workers**
  - **Diet dependent**
    - **Developing queens get “royal jelly” from youngest nurse bees**

Honey Bees 101 (cont.)

  - Developing workers and drones, as well as adult workers, adult drones and the queen, are fed “brood food” from older nurse bees
  - Nutrients for all gelatinous food begins as pollens
- **Pupation**
  - Fully fed larvae lay on their backs and spin a bit of cocoon
  - Worker bees seal the cells for pupation with air-and water vapor-permeable cappings

Honey Bees 101 (cont.)

- **Emergence**
  - **Queens – 16 days after egg is laid**
  - **Workers – 21 days after egg is laid**
  - **Drones – 24 days after egg is laid**

Honey Bee 101 (cont.)

- **Worker bees perform various tasks, depending upon their age**
  - **Most important are the workers passing through their second week post emergence**
    - **Those bees produce the gelatinous food for all the bees in the colony**
    - **Pollens are the source of nearly all of the nutrients**

Honey Bees 101 (cont.)

- **Progressive feeding**
  - **Jelly-producing bees place the jelly in front of larvae that are crawling around in a circle at the backs of the comb cells**
  - **In six days, a worker larva, hatching at 0.1 mg, grows to 100 mg, then pupates**
    - **At that rate of growth, a human baby born at eight pounds would weigh four tons in six days**

Honey Bees 101 (cont.)

Honey Bees 101 (cont.)

- **Summer worker bees shift to foraging bees after three weeks of house bee activities**
  - **Have about a 42-day life expectancy**
  - **Colony populations around 42,000 in summer**
- **Winter bees can persist up to six months**
  - **Remain in house bee condition until they begin rearing brood**
    - **Then have a six-week life expectancy**

Honey Bees 101 (cont.)

- **Foraging behaviors**
  - **Collect and bring back:**
    - **Water**
    - **Nectars**
    - **Pollens**
    - **Propolis – resins used as glue and varnish throughout the hive**
      - **Antibacterial, antifungal, and antiviral**

Honey Bees 101 (cont.)

- **Water**
  - **To drink – makes up over 90 percent of body weight**
  - **To humidify the brood nest**
  - **To air condition brood nest**
  - **Up to a gallon per day, when it is really hot and dry**
  - **Bees are not too picky about water sources**
    - **Can be a nuisance**

Honey Bees 101 (cont.)

- **Nectars**
  - **From flowers and extrafloral nectaries**
  - **From sucking insects, when called “honeydew”**
  - **Sugar concentrations from 5-85 percent**
    - **More dilute in mornings – solids increase due to evaporation**
    - **More dilute after irrigations or rains**
  - **Water evaporated to produce honey**
    - **Moisture content should be below 20 percent to avoid fermentation**
    - **Most California honeys around 13-13.5 percent moisture**

Honey Bees 101 (cont.)

- **Pollens**
  - **Sole source of major and minor nutrients required by honey bees**
    - **No one pollen has all the required nutrients**
      - **Almond (highly desired) and alfalfa (usually rejected) come close**
  - **Packed into comb cells and fermented by various fungi and bacteria**
    - **Stored for future use, pickled in lactic acid**
  - **Spring pollens stored for fall; fall pollens stored for spring**

Honey Bees 101 (cont.)

Honey Bees 101 (cont.)

- **Food consumption**
  - **A honey bee colony consumes about 50 pounds of pollen per year**
    - **Each pollen pellet per leg weighs about 25 mg**
    - **The bees must bring back nearly 1 million (909,100) pellets a year to meet this demand**
  - **A honey bee colony consumes about 100 pounds of honey per year**
    - **The extra may be harvested as a honey crop**
    - **If they don’t find it, we have to feed them sugar syrup**

Colony Collapse Disorder (CCD)

- **Name applied, in 2006, to an odd phenomenon in which all the adult bees just got up flew away, individually, over a few days' period of time**
- **Only the queen and a few brand new workers remained**
  - **They died in a few days (no nurse bees or brood food)**
  - **All stages of brood were present**
  - **Honey stores were good**
  - **Pollen stores were good**

Colony Collapse Disorder

- **Emergency Livestock Assistance Program (ELAP) in Farm Bill included honey bees for the first time in 2008**
- **CCD became, and remains, a media darling**
  - **Now "credited" with the relatively recent annual colony loss rate of around 30 percent**
    - **5-10 percent from 1622 through 1980s**
    - **15-20 percent after arrival of tracheal and varroa mites**

Colony Collapse Disorder

- **ELAP in current Farm Bill**
  - **Beekeepers reporting less than 10 percent of losses due to CCD**
  - **Varroa mites and starvation top the beekeepers' lists of causes**
- **Researchers have spent over $10 million studying CCD**
  - **Have placed the blame on overwhelming stresses, with no single, individual cause**

Honey Bee Stresses

- **Malnutrition**
  - **Just like other animals, the most robust individual bees are those that are well fed**
  - **Honey bee forage areas have been converted to housing tracts, highways, shopping malls and parking lots, airports, and expansive agricultural fields**
  - **We may be the only animal husbandry industry that cannot keep our animals alive for 12 months on supplemental feeds (pollen substitutes)**

Honey Bee Stresses

- **Metazoan parasites**
  - **Became problematic in the 1980s**
  - **Tracheal mite, *Acarapis woodi*, reached us from Europe in 1984**
    - **Spread over the country in about five years, killing one half of our bee colonies**
    - **Now not considered a problem**
  - **Varroa mite, *Varroa destructor*, reached us from another Asian bee species in 1987**

Honey Bee Stresses

- **Varroa mites**
  - **Spread across the country in about five years, killing half of our maintained bee colonies and nearly every one of our feral bee colonies**
    - **Critically reduced our gene pool**
  - **Currently considered our most difficult beekeeping problem, and that of the whole world where beekeepers use European stocks**

Honey Bee Stresses

- **Varroa mites**
  - **Gravid female mites enter pupation cells just as they are being capped**
  - **Mother mite lays eggs on or near the pupa, male egg first, then all female**
  - **Mother mite maintains feeding hole in pupa for offspring to feed**
  - **Brother mite mates with sisters and new females released when bee chews out and emerges**

Honey Bee Stresses

- **Varroa mites**
  - **Mites impact individual bees by:**
    - **Reducing the blood and protein content of host bees**
    - **Suppressing the host bee's immune system**
    - **Injecting a virulent strain of an RNA virus of honey bees**
      - **Deformed wing virus (DWV)**
      - **Virulent strain causes bees to emerge with unfurled wings, shrunken abdomens, and no viable future**
    - **Also vector other larval and adult bee diseases**
      - **Looks like all bee RNA viruses can be vectored by *Varroa***

Honey Bee Stresses

- **Honey bee diseases**
  - **Bacterial diseases of larvae**
    - **American foulbrood – tylosin**
    - **European foulbrood – oxytetracycline hydrochloride**
  - **Fungal diseases of larvae**
    - **Chalkbrood – no know treatment**
  - **Viral diseases of larvae**
    - **Sacbrood – no known treatment**

Honey Bee Stresses

- **Fungal disease of adult bees**
  - *Nosema apis*
    - **Original species from Europe**
    - **Treated successfully with fumagillin**
  - *Nosema ceranae*
    - **Exotic species from Asian honey bees**
      - **Replacing *N. apis***
    - **Honey bee health impacts not predictable**
    - **Treatment impacts with fumagillin not predictable**

Honey Bee Stresses

- **RNA viral diseases**
  - **Found in all colonies, but apparently strains differ**
  - **So far, 22 different ones have been named, sequenced and are in the molecular data bank**
  - **We have not found a way to reduce the levels of infection or treat infected bees**

Honey Bee Stresses

- **Pesticides**
  - **All are used to kill something ("…cide" means kill)**
  - **All stimulate a detoxification reaction in bees**
  - **History of bee-impacting chemicals**
    - **1800s – lead arsenate in orchards**
    - **Synthetics starting 1940s**
      - **Chlorinated hydrocarbons, organophosphates, carbamates, pyrethroids, neonicotinoids, etc.**
    - **Pyrethrum (pyrethrins) and other "organic" products can be problematic**

Honey Bee Stresses

- **Neonicotinoids are the current brunt of beekeeper and environmentalists' distain**
  - **They are quite innovative, and were thought to be environ-mentally friendly but:**
    - **They persist in soil and water for long periods**
    - **They demonstrate observable effects in invertebrates at extremely low concentrations**
    - **They have displaced many of the older pesticide formulations**
    - **They are one of our most-used agricultural chemicals**

Honey Bee Stresses

- **Neonicotinoids could be used as effective IPM products as spray formulations, but they are principally used as systemics**
  - **It is a prophylactic approach that treats every plant, regard-less of whether it needs it**
  - **Neonics pretty well prevent problems with sucking or chewing insects, but they contaminate nectar and pollen**
    - **Unlike other ag applications, the blossoms remain contaminated the whole time they are in bloom**

Honey Bee Stresses

- **Neonics are used at lowest dosages on agricultural plants**
  - **Nectar and pollen residues run around 4-10 ppb**
  - **Landscape and ornamental plant uses are at higher doses**
  - **Tree doses are among the highest doses**
    - ***Eucalyptus* trees in southern California, trunk and root treated with Merit® for lerp psyllids, had residue levels in the nectar of 500-550 ppb**
      - **192 ppb is LD_{50} for worker honey bees**

Honey Bee Stresses

- **Recent tank mix problems**
  - **Almonds and tree fruits**
    - **Fungicides, with no known toxicity to honey bees, when tank-mixed with insect growth regulators (IGRs) with no known toxicity to honey bees, and the newer adjuvants, can result in severe adult bee and brood losses**
    - **An estimated 80,000 colonies were damaged by those concoctions when they were sprayed on almond blooms this year**

Protecting Honey Bees

- **First, examine the fields to be treated to determine whether or not there are bees foraging there**
  - **Get out into the field; look and listen**
    - **Do not just look out the pickup truck windows**
    - **Honey bees will fly up to 4.5 miles to forage**
      - **Colony deaths from Penncap-M poisoning 4.5 miles from almond orchard**
    - **Grape cutworms were the intended targets in a weedy vineyard**

Protecting Honey Bees

- **Try not to contaminate pollen or pollen-collecting foragers**
  - **Often pollen is shed in the morning and is used up during the day**
    - **It does not get "reabsorbed" by the flowers**
  - **Apply pesticides after bee activity has quit for the day**
    - **If the pesticide dries before the next morning it is at least 50 percent less toxic to the bees**

Protecting Honey Bees

- **Try to select the insecticide that is least toxic to bees but will subdue the pest**
  - **There is a free PDF extension publication on this topic available through Oregon State University: “How to Reduce Bee Poisonings from Pesticides - 2013”**
    - **http://www.orsba.org/htdocs/home.php**

Protecting Honey Bees

- **There is a new publication on this topic from EPA:**
  - **http://www2.epa.gov/pollinator-protection/residual-time-25-bee-mortality-rt25-data**

Protecting Honey Bees

- **New EPA publication on RTs**
  - **Residual times**
    - **Time that pesticide residues persist at a level that will kill 25 percent or fewer bees that come into contact with them**

Protecting Honey Bees

- **Do not rely too heavily on the lack of bee warnings or prohibitions on the product labels**
  - **We are seeing too many cases of synergisms between unrelated agricultural products, when tank-mixed, to state that any of them are safe combinations**

Tank Mix Colony Damage

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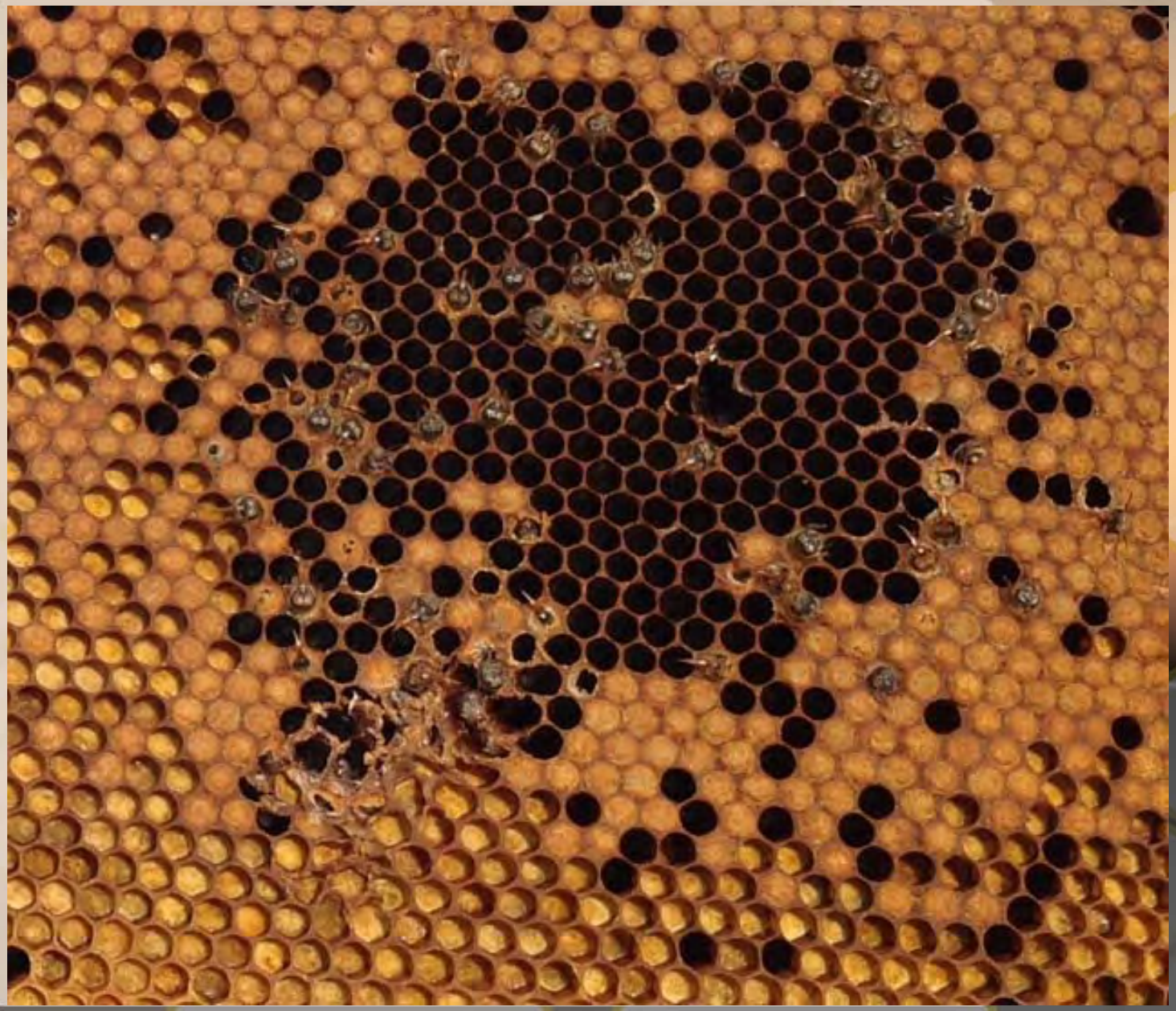
Tank Mix colony Damage



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