

# **VARROA DESTRUCTOR**

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**“The parasitic mite Varroa destructor is the greatest single driver of the global honey bee health decline.”**

**- Dr. Samuel Ramsey et al, 2019**

**“When left untreated, colonies with high levels of Varroa may die within months.”**

**- Tools for Varroa Management, page 6  
Honey Bee Health Coalition**

# TOPICS

## Part I

- Varroa
  - History
  - Reproduction cycle
- Monitoring
  - Alcohol wash
  - Sugar roll
- Chemical Controls

## Part II

- Non-Chemical Controls
  - Apiary design
  - Varroa resistant stock
  - Brood break
  - Brood frame removal
  - Screened bottom boards



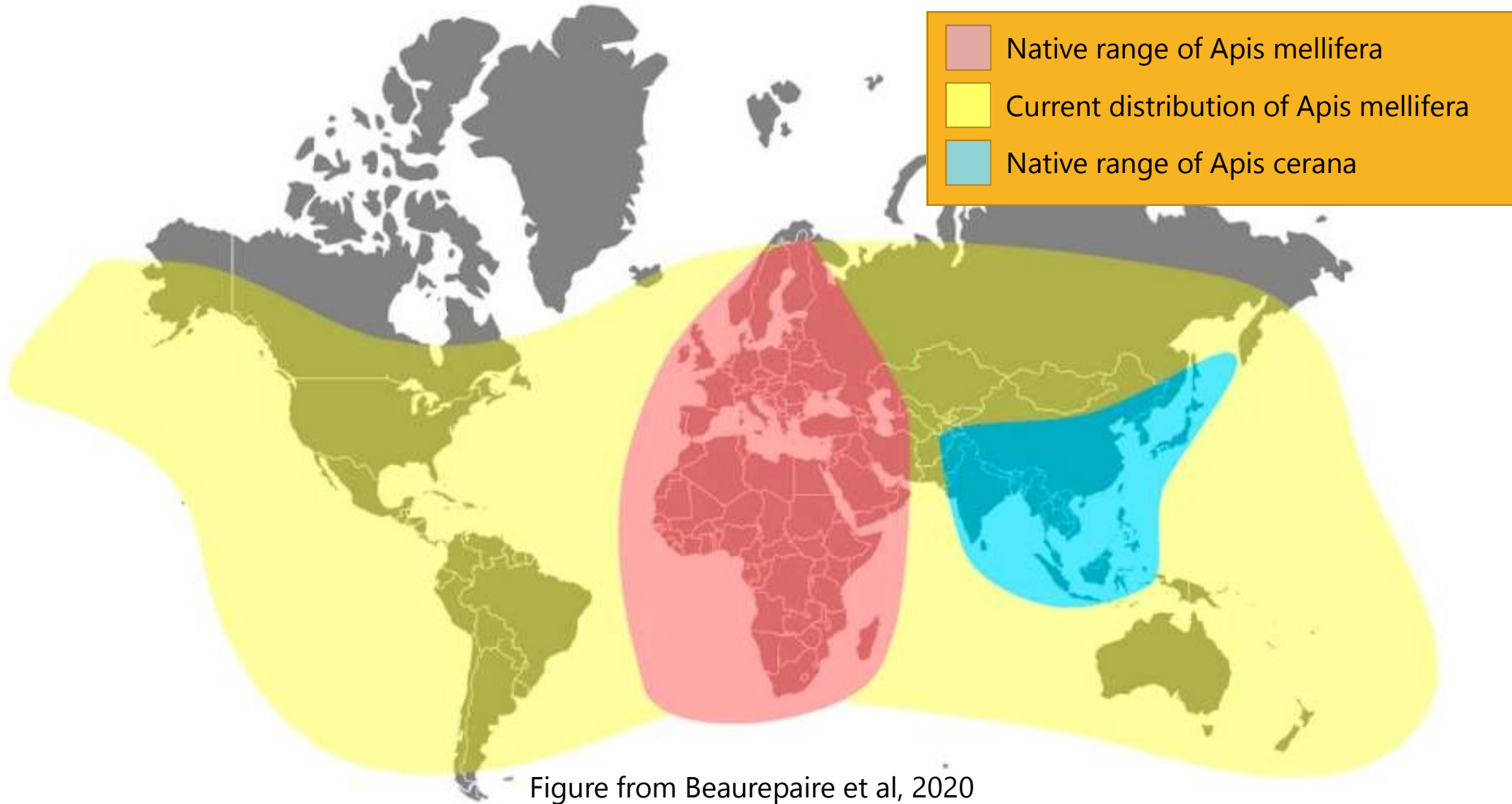
# PART I

THE ENEMY, MONITORING,  
AND CHEMICAL CONTROLS

If you know the enemy and  
know yourself, you  
need not fear the results  
of a hundred battles.

- Sun Tzu





# VARROA HISTORY

- The mite *Varroa jacobsoni* was known to live specifically with *Apis cerana*
- *Varroa jacobsoni* does not typically result in the death of an *Apis cerana* colony
  - *Varroa jacobsoni* only reproduces in the drone brood of *Apis cerana*
  - *Apis cerana* only produces a small number of drone brood
  - Afflicted worker brood of *Apis cerana* undergo social apoptosis (altruistic suicide) preventing mite reproduction

# VARROA HISTORY

- In the mid-20th century, *Varroa jacobsoni*, jumped species to *Apis mellifera*
- By 1987 *Varroa* was identified in the United States
- The mite quickly adapted to *Apis mellifera* and in 2000, a new species was identified as *Varroa destructor*



Adult female Varroa

Photo Credit:  
<https://aristabeerresearch.org/varroa/>



# VARROA DISTRIBUTION

Phoretic – “they move around the environment by attaching themselves to adult bees” – Tools for Varroa Management

Drifting – infested bees re-enter a hive other than their own

Mite Bombs – remaining bees from dying colonies move into nearby hives

Robbing – bees robbing dead hives of resources carry mites back to their home colony

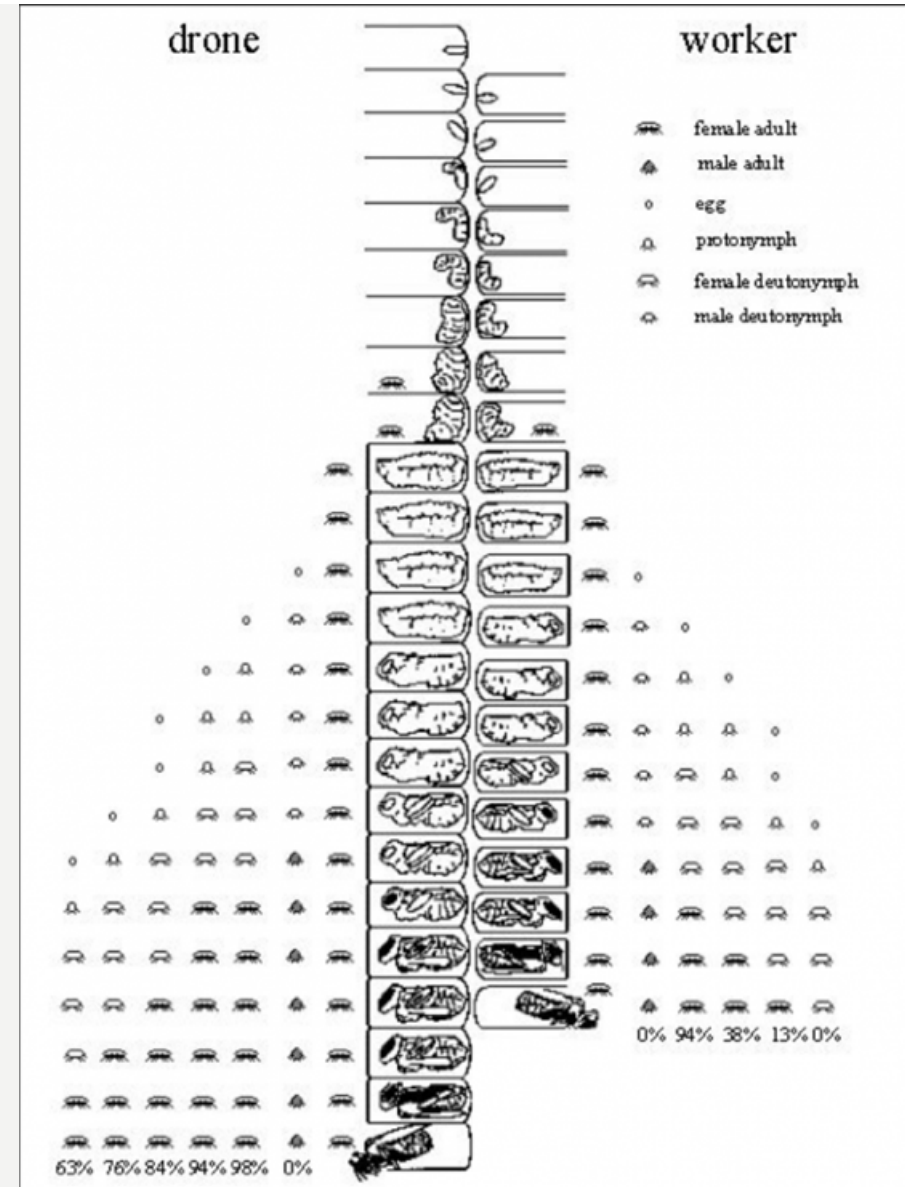
# VARROA BIOLOGY

- Varroa mites reproduce inside the capped brood of honey bees
  - Mated female Varroa enter cells with honey bee larvae before they are capped
  - On Day 3, an egg is laid for a male Varroa
  - Afterwards, an egg is laid for female Varroa each day
  - It takes 6 days for each female mite to mature
  - Any mites not fully developed when the honey bee emerges will die

# REPRODUCTION CYCLE

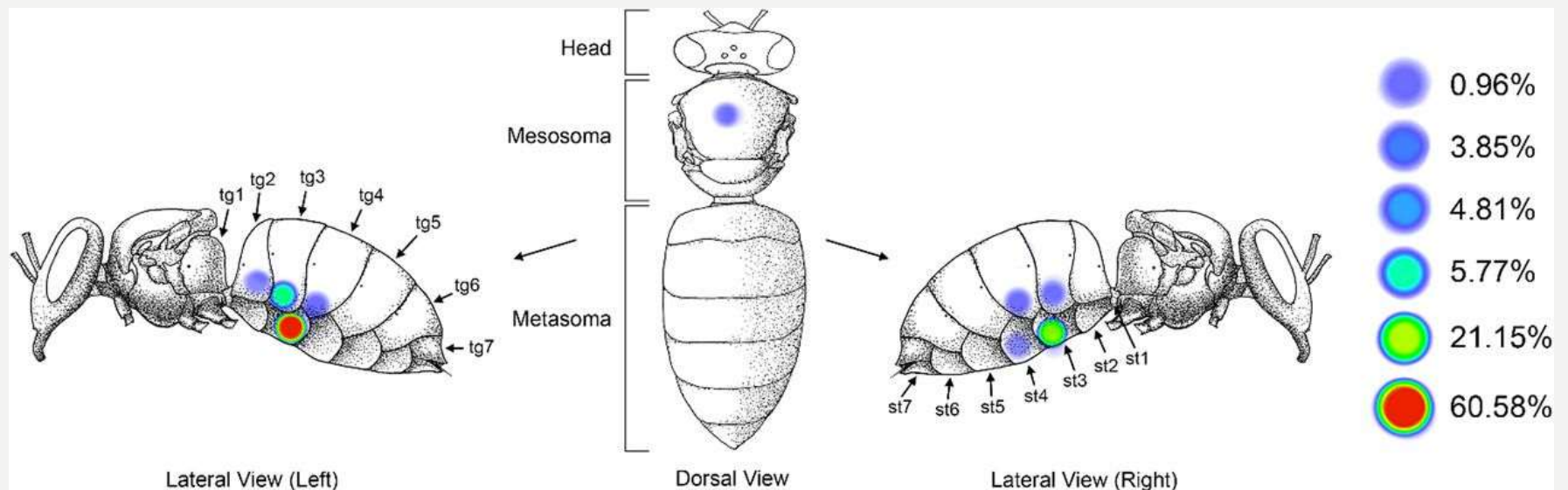
## Worker brood vs drone brood

- The illustration shows the potential for mite reproduction
- Fortunately, this full potential is rarely reached
- The general rule is that mite populations double about once a month when brood is present



# MITE TARGETS

- In a 2019 paper, Samuel Ramsey et al reported that Varroa destructor feeds on fat body tissues, not hemolymph
- Bee fat body tissues are essential to immune function



# DISEASES

## Deformed Wing Virus

- Only apparent in colonies with Varroa
- Bees lifespans significantly shortened
- Often wings appear shriveled
- Often die outside the hive

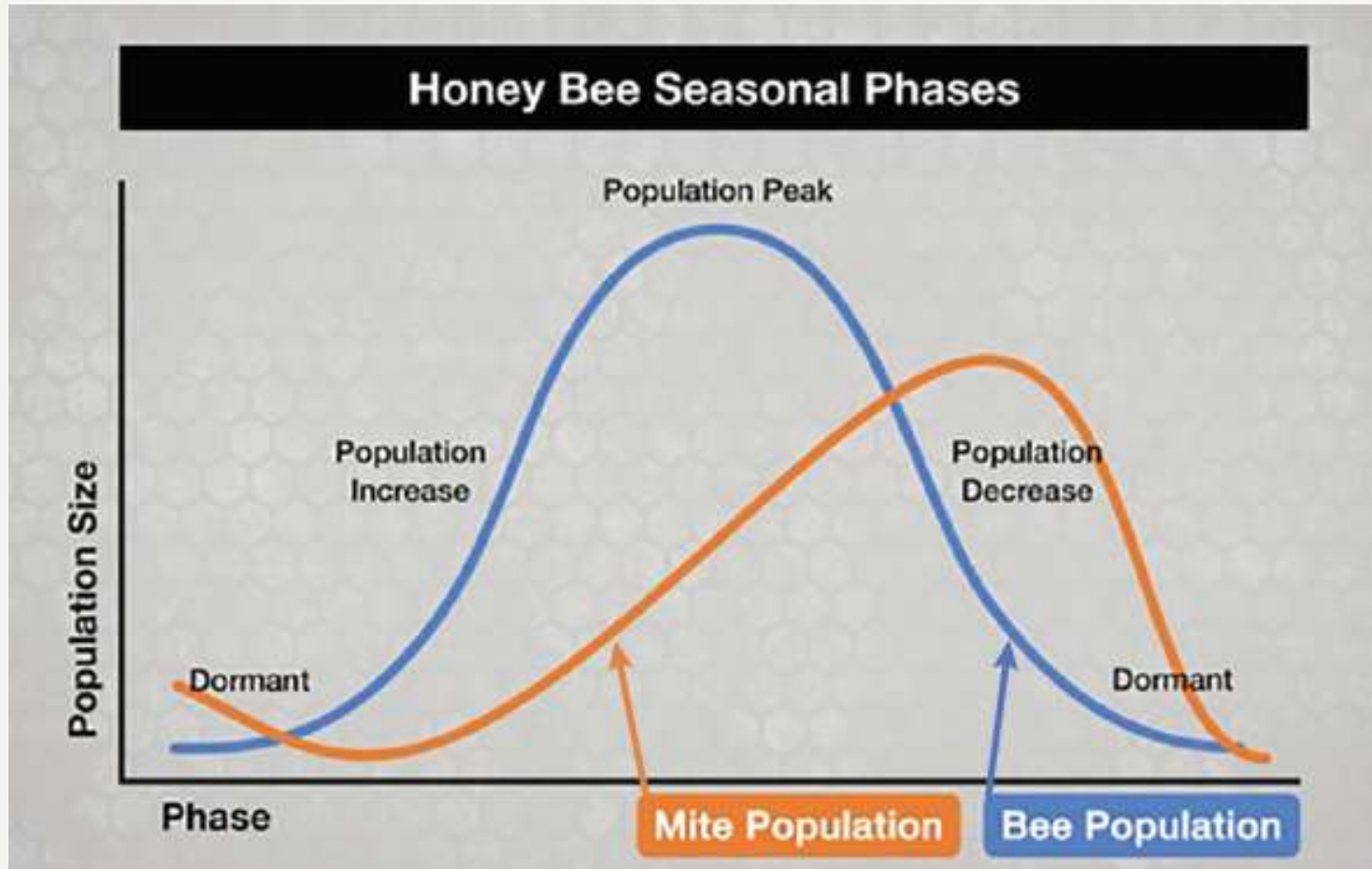
## Acute Bee Paralysis Virus

- Often asymptomatic until colony dies
- Multiplies fast and kills bees rapidly
- Symptoms of paralysis and tremors
- Often die outside the hive



Photo Credit: The Apiarist

# VARROA AND BEES



# WINTER (DIUTINUS) BEES

- Rather than living six weeks, these bees may live six months
- Long life may be due to increased fat body tissues, lack of brood rearing, and/or reduced flying
- Fat body tissues
  - Key to fighting diseases
  - Produce vitellogenin: essential to producing brood food even in the absence of pollen
  - Help colonies produce small numbers of brood during winter

# HONEY BEE HEALTH COALITION

## Integrated Pest Management

- Proactive non-chemical and chemical methods
- Rigorous monitoring
- Cultural practices
- Rotation of chemical products

<https://honeybeehealthcoalition.org/varroa/>

## TOOLS FOR VARROA MANAGEMENT

A GUIDE TO EFFECTIVE VARROA SAMPLING & CONTROL

HEALTHY BEES · HEALTHY PEOPLE · HEALTHY PLANET™



**HONEY BEE  
HEALTH  
COALITION™**

Seventh Edition - June 1, 2018

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# MONITORING

- Conduct monitoring 3-4 times per year
  - Spring, Summer, and Fall
  - Also, after treating to assess success
- Alcohol Wash
  - Most accurate monitoring of Varroa levels
  - 300 bees per sample are sacrificed
- Sugar Roll
  - Effective, but results are more variable
  - Finding the queen is not essential

# ALCOHOL WASH

- 1) Find the queen and ensure she is in a safe location
- 2) Shake bees from brood frames into a container
- 3) Scoop up 300 (~ ½ cup) of bees
- 4) Pour into alcohol wash
- 5) Shake for 1 minute
- 6) Count mites at bottom of container



# SUGAR ROLL

- 1) Find the queen and ensure she is in a safe location
- 2) Shake bees from brood frames into a container
- 3) Scoop up 300 (~ 1/2 cup) of bees
- 4) Place bees in jar with  
2 tablespoons powdered sugar
- 5) Shake for 1 minute
- 6) Set the jar down and wait three to five minutes
- 7) Shake container like a salt shaker onto a white plate
- 8) Spray the plate with water
- 9) Count the mites on the plate



Not recommended during high humidity or strong nectar flows.

# MITE COUNTS

- 1) Divide the number of mites by 3
- 2) This is your mite load per 100 bees



- 2 or less: continue to monitor
- 3 or more: treat bees for improved survivability\*

\* These recommended thresholds were reduced within the past few years

“Doing nothing about Varroa mites is not a practical option for most beekeepers. Honey bees are not capable of surviving or thriving unless the beekeeper prevents Varroa from reaching damaging levels. If the beekeeper does not control Varroa, a colony will most likely die and, in the process, spread mites and infections to other colonies in the same apiary and surrounding area.”

- Tools for Varroa Management, page 5  
Honey Bee Health Coalition

# CHEMICAL TREATMENTS

- Essential Oils
- Acids
  - Formic Acid
  - Oxalic Acid
- Synthetic Treatments



# CAUTION

- Read and follow all EPA label directions
- Wear appropriate personal protective equipment
  - Understand the specific requirements/hazards for any chemical you use
- Make sure those nearby are also protected or moved to a safe distance

# CONSIDERATIONS

- Efficacy
- Effort
- Honey supers on or off?
- Temperature range for a treatment
- Organic / Non-organic



# ESSENTIAL OILS

## Apiguard® – Thymol

| Consideration           |                                |
|-------------------------|--------------------------------|
| Efficacy                | 74-95% (warmer weather better) |
| Effort                  | Apply 2x separated by 2 weeks  |
| Honey Supers On or Off? | No use with honey supers       |
| Temperature Range       | 60-104°F (15-40°C)             |
| Organic / Non-organic   | Organic                        |



Photo Credit: LappesBeeSupply.com

Personal Protective Equipment: Gloves

# ESSENTIAL OILS

ApiLife Var<sup>®</sup> – Thymol + camphor, menthol & eucalyptol oil

| Consideration           |                                   |
|-------------------------|-----------------------------------|
| Efficacy                | 70-90%                            |
| Effort                  | Apply 2-3x separated by 7-10 days |
| Honey Supers On or Off? | No use with honey supers          |
| Temperature Range       | 65-85°F (18-30°C)                 |
| Organic / Non-organic   | Organic                           |



Photo Credit: MannLakeLtd.com

Personal Protective Equipment: Gloves

# ACIDS

## Formic Pro™ – Formic Acid

\* See also Mite-Away Quick Strips® (MAQS®)

| Consideration           |   |
|-------------------------|---|
| Efficacy                | 83-97%  |
| Effort                  | One treatment for 14-20 days                              |
| Honey Supers On or Off? | Allowed with honey supers                                 |
| Temperature Range       | 50-85°F (10-29.5°C)<br>Above 92°F can be damaging to bees |
| Organic / Non-organic   | Organic   |

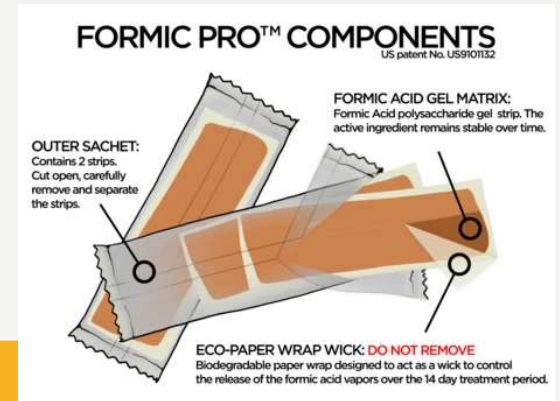


Photo Credit: Pierco.com

**Personal Protective Equipment:** Coveralls over long-sleeved shirt, long pants, socks, and shoes. Acid resistant gloves (e.g. nitrile) and protective eyewear. Respirator not required, but recommended.

# ACIDS

Oxalic Acid Vaporization (OAV) – oxalic acid dihydrate

| Consideration           |  |
|-------------------------|--|
| Efficacy                | 82-99% when brood not present                              |
| Effort                  | If capped brood:<br>3-4x treatments separated by 7-10 days |
| Honey Supers On or Off? | No use with honey supers                                   |
| Temperature Range       | No temperature restrictions                                |
| Organic / Non-organic   | Organic  |



Photo Credit: Dadant.com

**Personal Protective Equipment: Extremely dangerous to applicator health. Follow label directions. Wear proper respirator with cartridge & particulate filter, long pants, long sleeves, acid resistant gloves, and protective eyewear. (See next slide)**

# OXALIC ACID VAPORIZATION

- Oxalic acid vaporization is only effective against phoretic mites (those not under the wax caps of brood)
- To effectively treat a colony, the treatment must be repeated to cover an entire brood cycle
  - Treat every 7 days for 3 weeks or every 5 days for 4 weeks
- Safety
  - HBHC recommends using a full-face cartridge respirator with particulate filter. Use 3M model 6002 or 6003 filters. DO NOT use model 6001.

# OAV WITH HONEY SUPERS?

- FDA established an exemption for tolerance of oxalic acid in honey and honeycomb on February 23, 2021

Tolerance – "... the maximum amount of a specific pesticide allowed that is permitted in to be on a certain food that will be marketed in the US." - Milbrath

- EPA as not yet completed an update to the pesticide label for API-Bioxal, the only approved oxalic acid product for treating honey bees

Only products sold with an updated pesticide label allowing the use with honey supers on should be used

# ACIDS

Oxalic Acid dribble – oxalic acid dihydrate

| Consideration           |  |
|-------------------------|--|
| Efficacy                | 82-99% when brood not present              |
| Effort                  | Single treatment when brood is not present |
| Honey Supers On or Off? | No use with honey supers                   |
| Temperature Range       | No temperature restrictions                |
| Organic / Non-organic   | Organic                                    |

**Personal Protective Equipment: Extremely dangerous to applicator health. Follow label directions. Wear proper respirator with cartridge & particulate filter, long pants, long sleeves, acid resistant gloves, and protective eyewear. (See next slide)**

# OXALIC ACID DRIBBLE

- Mix 35 grams of oxalic acid into 1 liter of 1:1 sugar syrup
- Trickle 5 milliliters (ml) of solution directly onto bees in each seam of the brood box.
  - HBHC recommends a maximum of 50 ml per colony
  - Scientific Beekeeping suggest a maximum of 100 ml



Photo credit: tractorsupply.com



# ACIDS

HopGuard® II\* – potassium salt (16%) of hops beta acid

\* largely being replaced by HopGuard® 3

| Consideration           |   |
|-------------------------|---|
| Efficacy                | 75-95% when little to brood not present |
| Effort                  | 1-2x separated by two weeks             |
| Honey Supers On or Off? | Use allowed with honey supers           |
| Temperature Range       | No temperature restrictions             |
| Organic / Non-organic   | Organic                                 |



Photo credit: MannLakeLtd.com

**Personal Protective Equipment: Eye protection (faceshield or goggles), waterproof disposable gloves, and long sleeves, pants, socks, and shoes. May stain clothing.**

# SYNTHETIC CHEMICALS

## Apivar<sup>®</sup> – Amitraz

| Consideration           |  |
|-------------------------|--|
| Efficacy                | Up to 95%                                |
| Effort                  | 1x – 42-56 days. Treat all at same time. |
| Honey Supers On or Off? | No use with honey supers                 |
| Temperature Range       | No temperature restrictions              |
| Organic / Non-organic   | Non-organic                              |



Photo credit: Dadant.com / Apivar

**Personal Protective Equipment:** Wear coveralls over short sleeves, long pants, socks, and shoes. Wear chemical resistant gloves. Avoid inhalation of vapors or contact with eyes.

# SYNTHETIC CHEMICALS

Apistan® – Tau-fluvalinate (synthetic pyrethroid)

| Consideration           |   |
|-------------------------|---|
| Efficacy                | 95-99%                                      |
| Effort                  | 1x – 42-56 days. Treat all hives same time. |
| Honey Supers On or Off? | No use with honey supers                    |
| Temperature Range       | Temperatures > 50°F (> 10°C)                |
| Organic / Non-organic   | Non-organic                                 |



Photo credit: Dadant.com

Personal Protective Equipment: Wear latex gloves

# EXAMPLE SCHEDULE

## Organic Treatments

| Window                             | Condition  | Treatment   |
|------------------------------------|--|---|
| Mid-April – May                    | No supers<br>Temperatures:<br>- Apiguard <sup>®</sup> – 60-104°F<br>- ApiLife Var <sup>®</sup> – 65-85°F | Thymol-based treatment:<br>Apiguard <sup>®</sup> or<br>ApiLife Var <sup>®</sup> |
| Mid-June -<br>September            | Brood / no brood<br>Supers / no supers<br>Any temperature  | HopGuard II/3   |
| End of November/<br>early December | No brood, no super.<br>Temperature above 50°F  | Oxalic acid dribble   |

# EXAMPLE SCHEDULE

Includes Non-organic Treatments

| Window                         | Condition  | Treatment                      |
|--------------------------------|--|--------------------------------|
| Mid-April – May                | No supers  | Thymol-based treatment         |
| June – July                    | Monitoring detects mite loads $\geq 3$ ; remove supers (for now) | OAV                            |
| September                      | After removing honey supers                                      | Non-organic: Apivar or Apistan |
| End of November/early December | No brood, no super. Temperature above 50°F                       | Oxalic acid dribble            |



# PART II

NON-CHEMICAL CONTROLS &  
WHERE TO LEARN MORE

# APIARY DESIGN

Colonies living in tightly clustered apiaries:

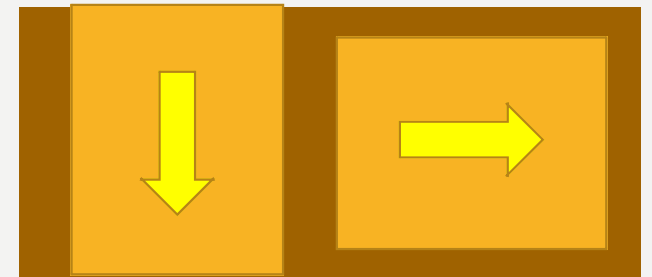
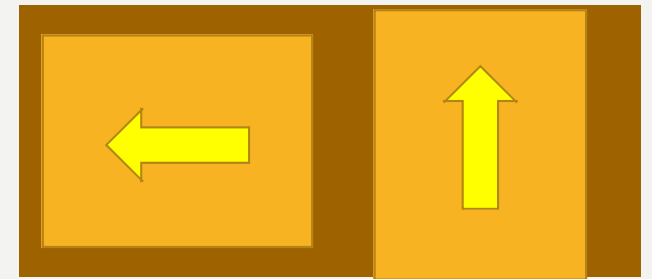
- Experience greater competition for forage
- At higher risks of being robbed
- More problems in reproduction
- Elevated risk of acquiring pathogens and parasites from neighbors

Drifting may be the most common mechanism of disease transmission

# APIARY DESIGN

Drifting can be reduced by

- Spacing
- Painting different colors
- Facing different directions  
(See Brother Adam layout at right)
- Supplying landmarks (navigation aids)

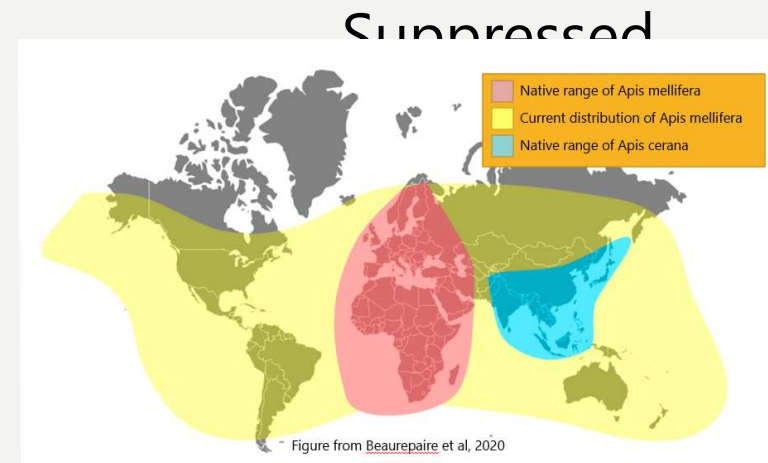




# RE-QUEEN - VARROA RESISTANT STOCK

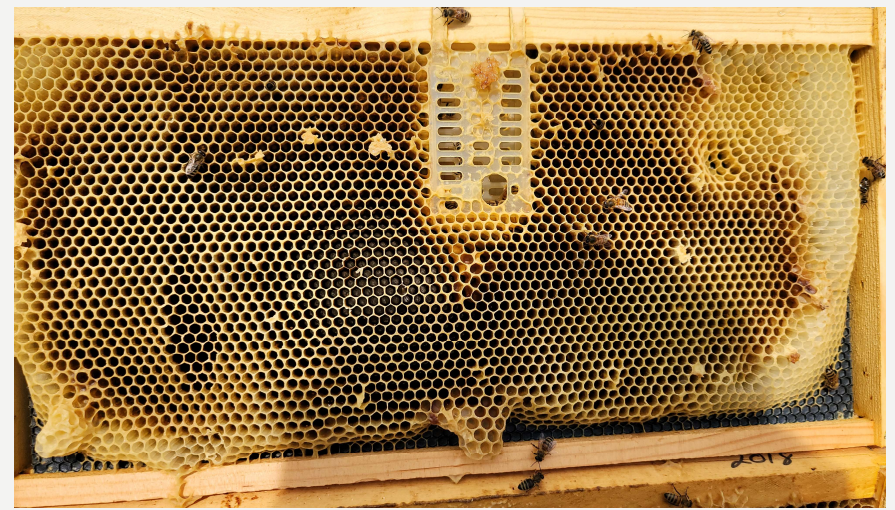
Several strains of bees are known to have or have been selected to have resistance to Varroa mites

- Varroa Sensitive Hygiene / Mite Reproduction
- Russian bees
- Minnesota Hygienic Queens
- Purdue ankle biters
- Buckfast bees and Buckfast hybrid bees
- BeeWeaver bees



# BROOD BREAK

- Varroa mites reproduce in capped brood cells
- Any time there is no capped brood in a hive
  - Mites are not reproducing
  - Are more vulnerable to threats
- Brood break methods
  - Splits
  - Re-queening
  - Caging the queen
- Brood break is the ideal time for treatments such as OAV



# DRONE BROOD REMOVAL

- Varroa mites prefer reproducing in drone brood
- During Spring build up, remove this frame when significant capped drone brood exists
- Nationally, 11% fewer overwintering losses; 10-33% fewer losses in northern states



Photo Credit: Dadant.com

# SCREENED BOTTOM BOARD

- Allows falling mites to drop out of the colony
- Effectiveness of up to 10% mite reduction in northern states
- Northern states report ~12% reduction in winter losses

# FURTHER READING

- Honey Bee Health Coalition
- Arista Bee Research
- Bee Informed Partnership
- Scientific Beekeeping

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