Integrated Pest Management (IPM) for *Varroa* Mite Control
**Integrated Pest Management**

**Integrated Pest Management (IPM)** is a strategy for maintaining a pest or parasite population below its economic threshold through the coordinated use of one or more methods. The economic threshold is the pest/parasite density at which one can expect economic damage (loss in honey production or colony death) if the beekeeper does not intervene with treatments or other control methods.

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**IPM Decision Making Tree for Varroa**

- **Below threshold**
  - Cultural methods
  - Screened bottom board
  - Break the brood cycle
  - Drone comb foundation
  - Swarming
  - Splitting
  - Cage queen
  - Requeen

- **Above threshold**
  - Natural chemical
  - Monitor for efficacy
  - Monitoring outcome

**Monitoring Frequency**

Beekeepers should monitor for Varroa mites every month, weather permitting. This will typically mean an inspection every month, April through October. When monitoring, a beekeeper should sample from at least ten percent of the colonies in each apiary to get a good estimate of Varroa in the apiary. When monitoring for Varroa, there are two options that have been shown to reliably correlate with overall mite population in the colony. These methods are the powered sugar shake and the alcohol wash.

Samples of bees or diseased brood can be sent to the USDA Beltsville Bee Lab in Maryland for a free analysis of Varroa, Nosema and Foulbrood.

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**IPM Programs Minimize Treatments**

IPM programs seek to minimize the use of chemical treatments and antibiotics and to eliminate their use when possible. Minimizing chemical treatments ensures the purity of hive products, extends the time it takes for parasites to develop resistance to treatments, and limits potential negative impacts on bees and the environment. IPM can prolong the time it takes for pests to reach the economic threshold that requires chemical treatment.

Beekeepers can always use genetic controls, regardless of the pest population levels. Monitoring regularly is key to IPM, as treatments should only be applied when colonies need them. Cultural practices can be implemented to reduce parasite and pathogen loads. Finally, chemical treatments (natural or synthetic) should be used only when pest levels exceed the economic threshold.

Monitoring again post-treatment will inform you of the efficacy of the treatment used.

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**Pyramid of IPM Practices**

- **Genetic**
  - Monitoring
  - Cultural methods
    - Natural chemicals
      - Synthetic chemicals
Using genetic stocks to reduce Varroa mite loads

<table>
<thead>
<tr>
<th>Stock</th>
<th>Description of the behavior</th>
<th>Institution that selected or imported stock</th>
<th>Mite life stage affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varroa-sensitive hygienic (VSH) bees</td>
<td>• Bees uncap and remove or chew infested pupae; immature mites die</td>
<td>USDA Bee Breeding Laboratory in Baton Rouge, Louisiana&lt;br&gt;Minnesota Hygienic Line, University of Minnesota</td>
<td>Reproductive</td>
</tr>
<tr>
<td>Grooming behavior bees</td>
<td>• Bees remove mites from their own bodies and/or their nestmates' bodies&lt;br&gt;• Stocks with grooming behavior also tend to express VSH behavior</td>
<td>Clemson University, South Carolina (still in development)</td>
<td>Phoretic</td>
</tr>
<tr>
<td>Ankle Biter bees</td>
<td>• Bees remove mites from their bodies and bite mites' legs off; mites can no longer attach onto bees</td>
<td>Purdue University, Indiana</td>
<td>Phoretic</td>
</tr>
<tr>
<td>Russian bees</td>
<td>• Russian bees encountered mites nearly a century ago and have had more time to naturally develop tolerance&lt;br&gt;They have increased VSH behavior and cease brood production (causing a break in the brood cycle) in times of food shortage</td>
<td>Imported by the USDA Bee Breeding Laboratory in Baton Rouge, Louisiana</td>
<td>Reproductive</td>
</tr>
</tbody>
</table>

Notes:
Phoretic mites: adult mites present on bee bodies
Reproductive mites: reproducing mites present in capped pupae

Q: I'm only going to try new stock in some of my colonies. How do I introduce this new stock?

A: When introducing new stock in a subset of your colonies, it will be most effective if these colonies are kept in a separate yard from colonies with non-Varroa tolerant/resistant stock. Having these colonies in the same yard can reduce the stock efficacy as drifting and robbing can introduce high mite pressure into resistant/tolerant stock colonies.

Q: I like my current bees and prefer local stock. Can I select for my own mite resistant stock?

A: Yes! There are two ways to do this:

**Option 1:** When monitoring Varroa mites in your bee yard, move any colonies that are above the treatment threshold to a separate yard and treat them individually. Keep low mite colonies in your original yard; these low mite colonies will be the ones from which you raise queens. Continue to move high mite colonies to this separate yard for 1-2 years, each time that you find some are above the economic threshold. You will be left with some colonies (now your breeder queen colonies) in your original bee yard that have maintained low levels of mites for 1-2 years.

**Option 2:** When monitoring Varroa mites in your bee yard, move any colonies that are above the treatment threshold to a separate yard - *isolated by a few miles from other colonies* - but do not treat them. Continue to monitor these moved colonies for 1-2 years. Any colonies able to survive the mite pressure may have begun developing resistance to mites. Raise queens from these colonies.

**Important note for both options:** Having colonies with high mite loads near other colonies can be a risk to those colonies with low mite loads. Drifting and robbing can introduce mites into colonies. It is important to keep colonies for breeding separate from your other hives and your neighbors' hives.
<table>
<thead>
<tr>
<th>Method</th>
<th>How It Works</th>
<th>Months</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **Drone comb frame**          | • Mites prefer to reproduce in drone comb and crawl inside right before cells are capped.  
                                 |              | • Don’t forget to remove the frame before drones emerge or you will accidentally increase mite levels.  
                                 |              | • Drones are produced most in spring and early summer and less in late summer and autumn.  
                                 |              | • This method is not ideal if your goal is queen rearing. A surplus of drones is needed for mating. |
|                               | • Insert frame in position 2 or 3 of brood nest. Remove while drones are capped (between day 10 and 24). Freeze the frame for 24 hours and reinsert. | April – August |                                                                                             |
| **Removing drone brood**      | • Mites prefer to reproduce in drone comb. While inspecting colonies, destroy/scrape off any drone comb with your hive tool. | April – August | • Drones are produced most in spring and early summer and less in late summer and autumn.  
                                 |              | • This method is not ideal if your goal is queen rearing. A surplus of drones is needed for mating. |
| **Screened bottom board**     | • Screened bottom board sits beneath the hive in place of bottom board. It catches mites that fall off bees and prevents them from crawling back up onto bees.  
                                 |              | • Screened bottom board provides additional ventilation.  
                                 |              | • In the Northeast it is recommended to remove screened bottom board before winter. In warmer regions, or areas protected from wind, screened bottom boards may be left on all year round |
|                               | • This approach is only effective together with other Varroa control methods. | April – October |                                                                                             |
| **Small colonies with few honey supers** | • Colonies that have small populations in smaller cavities produce less brood and have reduced mite levels. | Year round | • This method is not ideal if your goal is honey production. |
| **Colony spacing**            | • Drifting bees comprise around 30% of bees in colonies that are close together. Wild colonies are spaced far apart in nature. Crowding hives close together increases mite levels.  
                                 |              | • This method is dependent on land availability and may be more appropriate for hobbyists or sideliners with fewer hives.  
                                 |              | • Colonies can be overwintered close together, as there is no drifting/robbing during this time. |
|                               | • Spacing colonies more than 10 feet apart can help reduce mite transmission. | April – November |                                                                                             |

**Brood interruption techniques**

<table>
<thead>
<tr>
<th>Method</th>
<th>How It Works</th>
<th>Months</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Swarming</strong></td>
<td>• Allowing colonies to swarm provides a natural break in the brood cycle.</td>
<td>April – June</td>
<td>• Most swarms occur in spring and early summer, fewer occur in late summer and early fall. Swarms must be caught.</td>
</tr>
<tr>
<td><strong>Splitting</strong></td>
<td>• Strong colonies can be split into two smaller colonies. The colony without the original queen experiences a brood break. Many beekeepers will requeen both colonies.</td>
<td>April – July</td>
<td>• Colonies split in late summer or early fall might be too small to overwinter successfully.</td>
</tr>
<tr>
<td><strong>Requeening</strong></td>
<td>• Requeening colonies offers a break in the brood cycle. The break is longest if a queen cell is introduced instead of a mated queen.</td>
<td>April – July</td>
<td>• Benefits are maximized if requeening with tolerant/resistant stock.</td>
</tr>
<tr>
<td><strong>Caging the queen</strong></td>
<td>• Cage queen for 1-2 weeks to break the brood cycle. Release the queen after this time to allow her to return to egg laying.</td>
<td>April – July</td>
<td>• Caging the queen in late summer or early fall can interrupt the production of winter bees.</td>
</tr>
</tbody>
</table>
Chemical treatments for managing Varroa mites

<table>
<thead>
<tr>
<th>Chemical Treatment</th>
<th>Active Ingredient</th>
<th>Method</th>
<th>Efficacy</th>
<th>Cost per colony</th>
<th>Treatment duration</th>
<th>Can you treat with supers on?</th>
<th>Time to wait after treatment ends before you can super</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apiguard®</td>
<td>Thymol</td>
<td>Tray with gel sits on brood frames</td>
<td>74-95%</td>
<td>$3.30 - $6.80</td>
<td>28 days (2 times for 14 days each)</td>
<td>No</td>
<td>Can super immediately after treatment ends</td>
</tr>
<tr>
<td>Api Life Var®</td>
<td>Thymol, eucalyptus oil, menthol</td>
<td>Tablets placed on the corners of the brood nest</td>
<td>70-90%</td>
<td>$4.48 - $7.12</td>
<td>21-30 days (3 times at 7-10 day intervals)</td>
<td>No</td>
<td>1 month</td>
</tr>
<tr>
<td>MiteAway Quick Strips®</td>
<td>Formic acid</td>
<td>Pads placed on brood nest</td>
<td>61-98%</td>
<td>$4.40 - $7.25</td>
<td>7 days</td>
<td>Yes</td>
<td>Supers can be left on during treatment</td>
</tr>
<tr>
<td>Oxalic Acid</td>
<td>Oxalic acid dehydrate</td>
<td>Dribble brood nest or vaporize entrance</td>
<td>82-99%</td>
<td>$0.25 - $0.37</td>
<td>10 minutes</td>
<td>No</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Hop Guard II®</td>
<td>Hops beta acids</td>
<td>Strips inserted in brood nest</td>
<td>75-99%</td>
<td>$3.33 - $3.80</td>
<td>28 days</td>
<td>Yes</td>
<td>Supers can be left on during treatment</td>
</tr>
<tr>
<td>Apivar®</td>
<td>Amitraz</td>
<td>Insert strips into brood nest</td>
<td>95%</td>
<td>$5.00 - $6.90</td>
<td>42-56 days</td>
<td>No</td>
<td>2 weeks</td>
</tr>
</tbody>
</table>

The treatments Apistan® and CheckMite+® are not included in this table because we do not recommend beekeepers use them. They remain in wax for years and mites have developed resistance. There have also been cases of resistance to Apivar®. It is important to rotate treatments, remove treatment strips promptly, and practice Integrated Pest Management to reduce the likelihood of resistance developing to any treatment. Make sure you monitor after the treatment is finished (or regularly every month) to determine efficacy.

Efficacy levels are cited from Honey Bee Health Coalition, 2017. Tools for Varroa management: a guide to effective Varroa sampling and control, 5th edition. These levels refer only to treatments applied as specified by the label.

Treatment costs per colony vary depending on supply companies and order size.
## Varroa mite control options throughout the year

<table>
<thead>
<tr>
<th>Month</th>
<th>Colony conditions</th>
<th>Threshold (mites / 100 bees)</th>
<th>Cultural / Genetic Options</th>
<th>Natural chemicals</th>
<th>Synthetic chemicals</th>
</tr>
</thead>
</table>
| April | • Colony population increase  
• Brood present  
• Drone production | 2 | • Requeen with hygienic stock  
• Drone brood removal  
• Splits/artificial swarms  
• Colony spacing  
• Cage queen | Apiguard®  
Api Life Var®  
MiteAway Quick Strips®  
Oxalic acid (packages only) | Apivar®  
Apistan® |
| May   | • Colony population increase  
• Brood present  
• Drone production | 2 | • Requeen with hygienic stock  
• Drone brood removal  
• Splits/artificial swarms  
• Colony spacing  
• Cage queen | Apiguard®  
Api Life Var®  
MiteAway Quick Strips®  
Oxalic acid on packages only | Apivar®  
Apistan® |
| June  | • Colony population increase  
• Brood present  
• Drone production | 2 | • Requeen with hygienic stock  
• Drone brood removal  
• Splits/artificial swarms  
• Colony spacing  
• Cage queen | MiteAway Quick Strips®  
Hop Guard II® | |
| July  | • Colony population peak  
• Brood present  
• Drone brood present | 2 | • Requeen with hygienic stock  
• Drone brood removal  
• Splits/artificial swarms  
• Colony spacing  
• Cage queen | MiteAway Quick Strips®  
Hop Guard II® | |
| Aug   | • Colony population peak  
• Brood present  
• Fewer drones produced | 3 | • Requeen with hygienic stock  
• Colony spacing  
• Cage queen | MiteAway Quick Strips®  
Hop Guard II® | |
| Sept  | • Colony population peak  
• Brood present  
• Fewer drones produced | 3 | • Requeen with hygienic stock  
• Colony spacing  
• Cage queen | MiteAway Quick Strips®  
Apiguard®  
Api Life Var®  
Hopguard II® | Apivar®  
Apistan® |
| Oct - Nov | • Population decrease  
• Little to no brood | 3 | • Colony spacing  
• Cage queen | Oxalic acid  
Hop Guard II® | |
| Dec - March | • Bees are clustering  
• Broodless  
• Too cold to open colonies | 3 | | Oxalic acid (fumigation only) | |