On set phenomena of resistance to the active principles

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UMF
HONEY

Resistance

Resistance is **a genetically-based characteristic** that allows an organism **to survive exposure to a pesticide** dose that would normally have killed it. (**FAO.2012**)

- **Certain pest control practices** have consistently been shown to exacerbate the loss of susceptible pest populations and the development of resistance. **(FAO.2012)**

Causes

1. Frequent use of **a single pesticide** or **closely related pesticides** on a pest population;
2. The **application rates** that are below or above those recommended on the label;
3. **Poor coverage** of the area being treated;
4. **Frequent treatment** of organisms with large populations and short generation times;
5. **Failure to incorporate non-pesticidal** control practices when possible; and
6. Simultaneous **treatment** of **larval** and **adult** stages with single or related compounds. **(FAO.2012)**

Resistance mechanisms

1. Metabolic detoxification (enzymatic).

- MD is most often found in insects.
- It is based on enzyme systems that insects have developed to detoxify naturally occurring toxins found in their host plants and in the blood ingested.
- Range from compound specific resistance to very general resistance to a broad range of compounds.

2.Reduced sensitivity at the target site

- The binding site of the pesticide is changed so that it cannot effectively bind to the target site, thus eliminating or significantly reducing the pesticide's effectiveness.

3. Reduced penetration.

slows the penetration of the pesticide through the cuticle of resistant insects.

4. Behavioral resistance.

Any modification in the organism's behavior that helps to avoid the lethal effects of pesticides

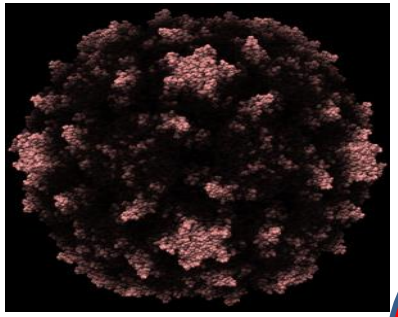
- Example: Varroa populations will eventually develop **resistance to any chemical varroacide .**
- **Individual variation within a mite population may result in small numbers of mites with resistant traits:**

1. ***A thicker cuticle that prevents entry of the active ingredient,***
2. ***A metabolism that may break down the treatment before it does the mite damage).***

✓ These characteristics are **genetic** and thus **heritable,**

✓ **Residues** of **varroacide** in beeswax accelerates the development of resistance in Varroa destructor

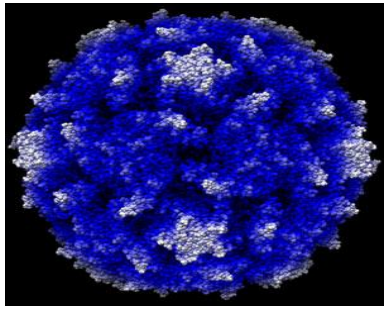
How Varroa mites impact honey bee health



Virus

Honey bee

Virus



Varroa

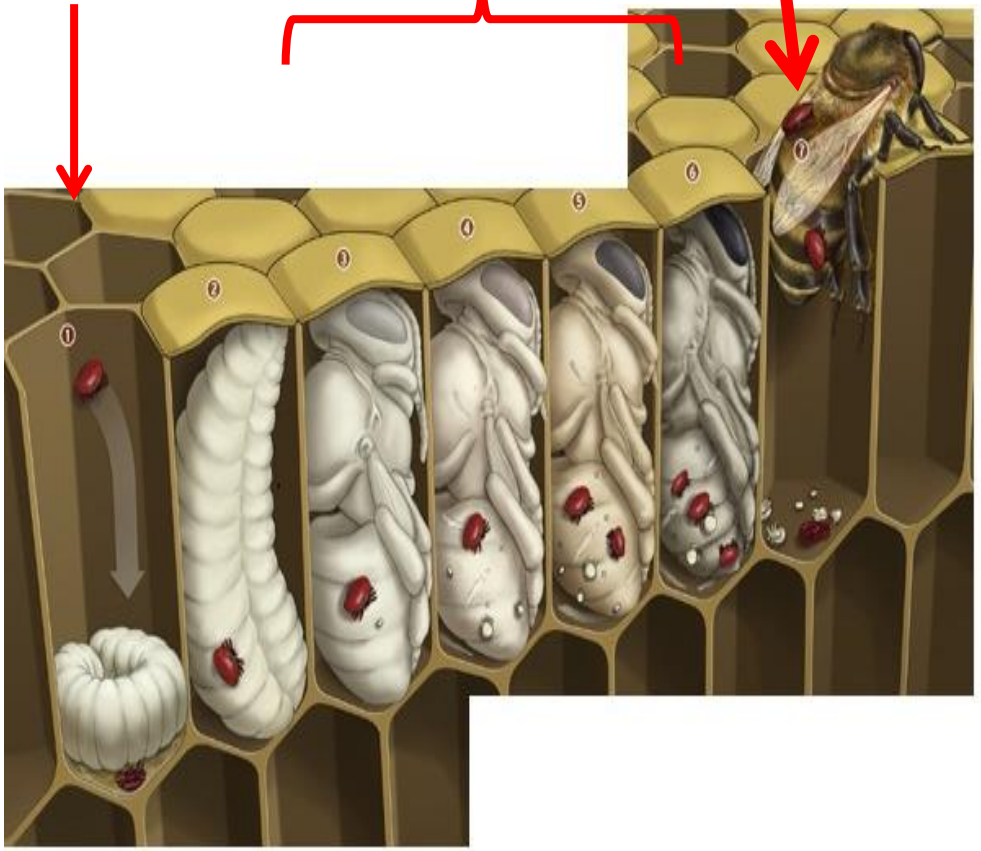
Viruses

- **Vector viruses**
- **Suppress the immune system**

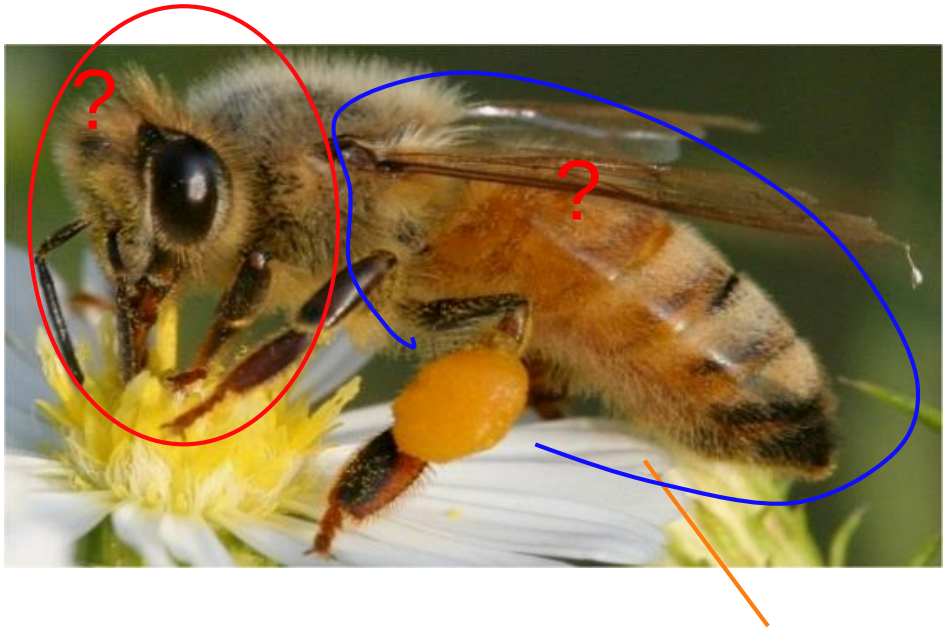
Varroa emerges out with the emerging adult bee

Varroa enters larval cell

Varroa feeds on bee larvae and multiply



Body localization and Tissue tropism ?



DWV- ???

Ref. Iqbal and Mueller 2007. Virus infection causes specific learning deficits in honeybee foragers. Proc. R. Soc. B 274, 1517-1521

Ex. Development of varroacide resistance.

1. Initially only a very few mites are varroacide resistant.
2. However, these **mites** and their **offspring** will survive successive treatments,
3. Over a period of time become more abundant.
4. Eventually they will comprise the majority of the mite Population

How long this process takes depends:

1. On **how often** Varroa mites **are exposed** to a varroacide (exposure period).
2. At what dose.

Frequent treatments, especially when misused or when treatment strips are left in the colony for longer than recommended, accelerate **the development of resistance.**

Treatment

1) Pesticides based on natural compounds:

1. **Thymol & essential oils: Apiguard, Thymovar & Apilifevar.**
2. **Formic acid: Api plus.**
3. **Oxalic and citric acids.**

***Their efficiency in the hive is temperature dependent.**


BioVet
THYMOVAR®
INDICATION


Apiplus


Apivar
Apivar

2) Synthetic pesticides

1. **Pyrethroids:** Fluvalinate - Apistan (Mavrik)
   Acrinathrin - Gabon.

   Flumethrin - Byvarol.
2. **Amitraz:** Apivar and by Tak-tic fumigation.
3. **Organophosphate:** Coumaphos - CheckMite+ and Perezin.

   Malathion - Mixed with sugar powder or flour.

Apistan (Tau-fluvalinate) for Varroa Control
Active ingredient (10% fluvalinate)

How to test for resistance

1. **Rule of thumb test**

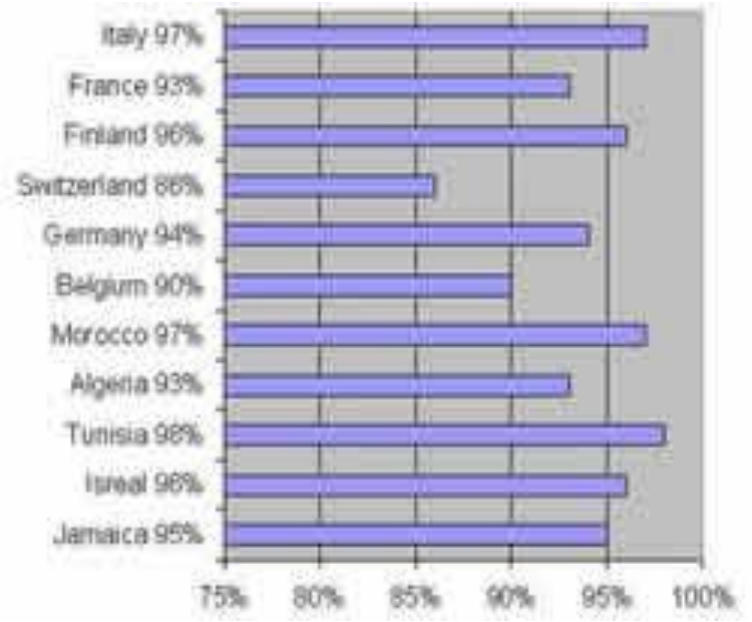
Place an Apistan strip in a colony. If after 24 hours there is a mite drop rate in the hundreds, Apistan's active ingredient will be having a sufficient effect to enable its use for that season. Make sure that the mite drop is not being removed by bees or other creatures before you retrieve it and the assumption is that your bees have a significant population of varroa in the first place.

2. **Rigorous test/Field resistance test.**

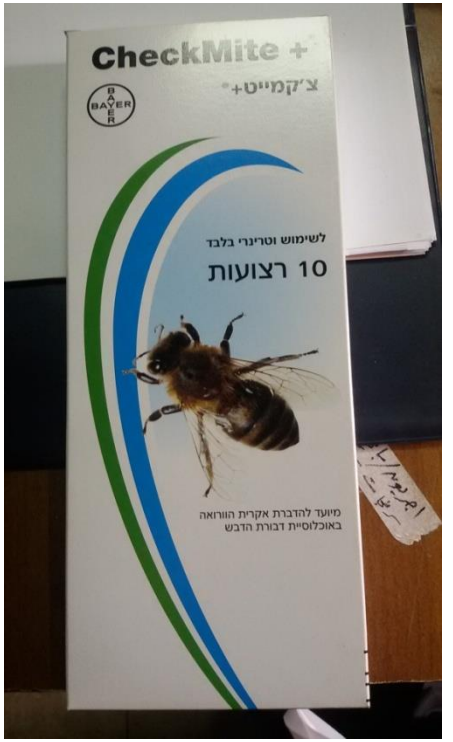
Around 300 adult bees are collected in a test container, to which an Apistan Package Bee Strip is inserted. After 3 hours the mite mortality is assessed and the presence or absence of resistance can be determined.

Apiguard for Varroa Control
AI (Thymol).

- ✓ High efficiency against hive pest: **varroa mites, trachael mites / Acarine and chalkbrood.**
- ✓ Used against varroa mites resistant to **pyrethroids**



In the Palestinian Markets



Resistance phenomena to amitraz from populations of the ectoparasitic mite Varroa destructor AI (3.33% amitraz)

- The LC(50) values were 3.9, 3.5, and 3.7 μg/Petri dish for mites from three different apiaries.
- Significant LC(50) differences were detected between resistant and susceptible mites.

- Maggi MD1, Ruffinengo SR, Negri P, Eguaras MJ. Resistance phenomena to amitraz from populations of the ectoparasitic mite Varroa destructor of Argentina. Parasitol Res. 2010 Oct;107(5):1189-92. doi: 10.1007/s00436-010-1986-8. Epub 2010 Jul 29


الشرائط المضادة للعثة الطفيلية على النحل
(للاستخدام البيطري)
WEE'S 汪氏
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(للاستخدام البيطري)
WEE'S 汪氏
ماڤرك وانجس
المكونات : ثايمول ١٠ ٪ وزن / وزن
إن شرائط ماڤرك وانجس تحتوي على مادة شديدة وسريعة التأثير
على الفاروا - (Varroa Jacobsoni Oud) ولفترة طويلة .
لايوجد لهذه المادة المحسة اي تأثير جانبي على الانسان ولاتترك اي اثر متبقي في منتجات النحل
المحتويات ١٠ أشرطة


FRONTLINE®
SPRAY
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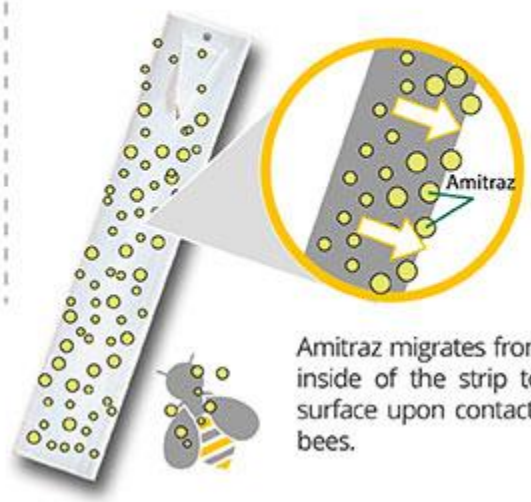
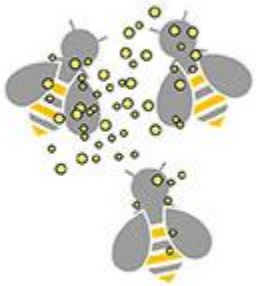
Only for use by or under
the supervision of a veterinarian
Slegs vir gebruik deur of onder
die toesig van 'n veearts
250 mℓ
MERIAL

1 Bees walk on the strips, **picking up molecules of amitraz.**



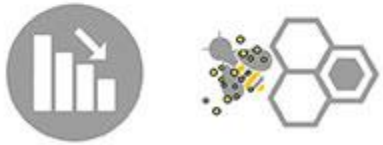
Amitraz migrates from the inside of the strip to the surface upon contact with bees.

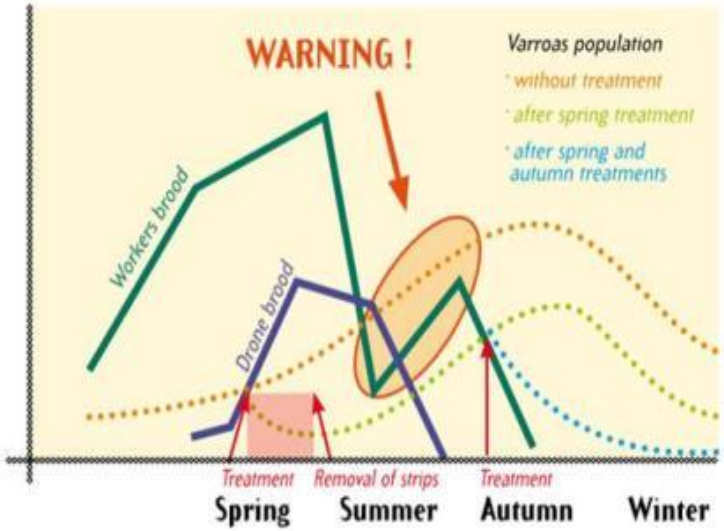
2 **The bees distribute amitraz through contact with each other.**



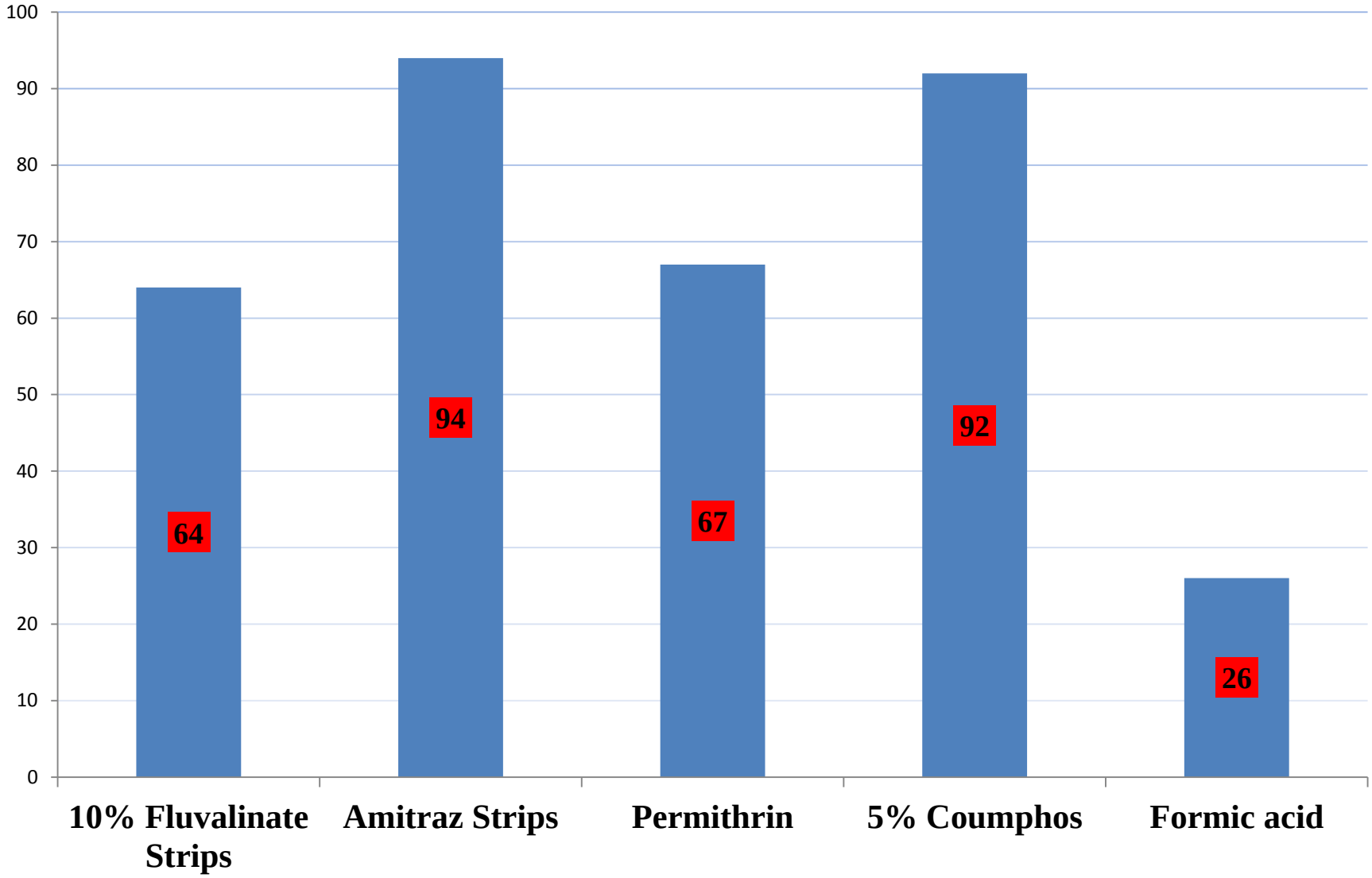
3 **Mites on the bees are exposed to the amitraz** which leads to **paralysis and starvation.**

4 **The mite population drops and subsequent mite generations are also killed.**

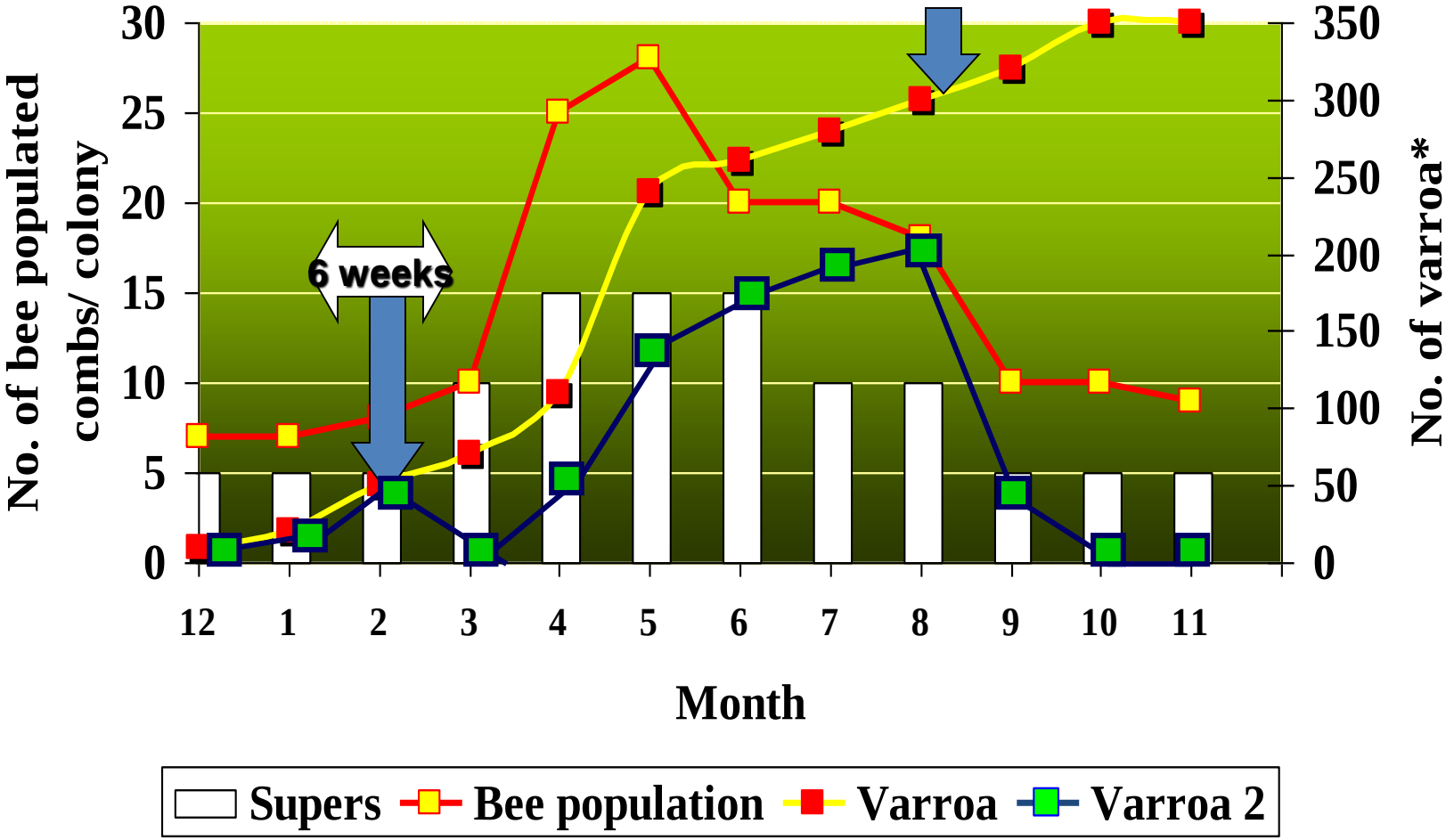




% Varroa Reduction



Honeybee and varroa annual life cycles in Israel, timing of treatments



*One hour after fumigation with amitraz on the sticky bottom board.

Ref. Beekeeping in Israel 2012.ppt

Oxalic acid

No Oxalic Acid resistant possible. It works by destroying the mite's suction ability, stopping it from feeding from the bee. Effectively, the mite starves to death.

Michael Young . Using Formic & Oxalic Acids for treatment of Varroa & Tracheal & Honey bee parasitic mites. Institute of Northern Ireland Beekeepers.

Evaluation of Oxalic Acid treatments against the Mite Varroa destructor and Secondary Effects on Honey Bees Apis mellifera.

***Noureddine Adjlane, El-Ounass Tarek , Nizar Haddad**

Journal of Arthropod-Borne Diseases · December 2015

Methods: Treatment of 30 colonies kept in Langstroth hives kind. Oxalic acid dripped directly on bees 5ml of this solution of oxalic acid per lane occupied by a syringe. Three doses were tested: 4.2, 3.2 and 2.1% oxalic acid is 100, 75 and 50 g of oxalic acid dehydrate in one litter of sugar syrup (1water to1 surge) concentration.

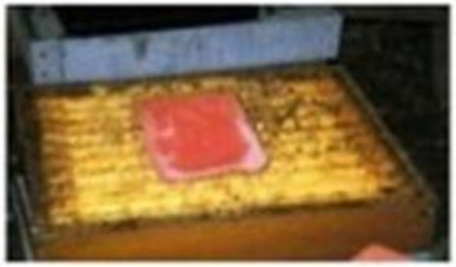
Results: The percentage of average efficiency obtained for the first dose was 81%, 72.19% for the second dose, and 65% for third one, while the dose of 100 g oxalic acid causes a weakening of honey bee colonies.

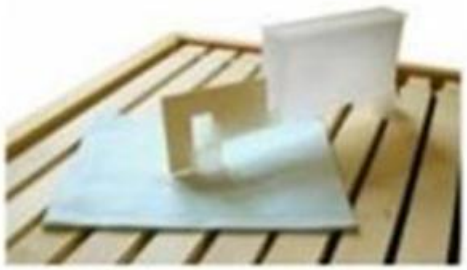
Conclusion: The experiments revealed that clear variation in the treatment efficiency among colonies that this might be related to brood presence therefore in order to assure the treatment efficiency oxalic acid should be part of a big- ger strategy of Varroa treatment.

Formic acid

Formic acid treatment

- Cauterization of varroa
- Partly effective on brood
- High precision and experience required
- Protective measure when handling the acid
- Sponge/flash treatment
  - 2ml/comb 60% acid
  - 2-3 treatments with a 7-day interval
- Evaporator/long-term treatment
  - Medicine bottle, evaporator, Nassenheider
  - Evaporation principle 10-15 ml 60% or 85% acid/day over 10 days
  - Empty space required (reversed feeding tray, super)





American Foulbrood (AFB)

- ✓ A bacterial disease caused by *Paenibacillus larvae larvae.*
- ✓ It afflicts queen, drone, and worker larvae alike.
- ➢ Preventative antibiotic application:
- ✓ Time of application: Spring & fall.
- ❖ Oxy-Tetracycline-

1. Oxy-Tetracycline sugar syrup mix (28 g/2S).

A sample of AFB infected combs to the Apiculturist lab to test for Oxy Tetracycline resistance.


Honeybee
Foulbrood Test Kit
AFB Diagnostic Kit
Batch: 206


How to use the Vita
Honeybee Foulbrood Test Kit
Refer to full instructions enclosed
T C
Result
T C

Screening alternative antibiotics against oxytetracycline-susceptible &-resistant *Paenibacillus larvae*

- Resistance of *Paenibacillus larvae* subsp becoming widespread.
- 21 antibiotics/ 8 classes, were screened against susceptible P. l. larvae using the same dosage series.
- Aminoglycoside antibiotics were either completely inactive at all concentrations tested (amikacin, kanamycin, neomycin, paromomycin, or streptomycin)
- Active only at 4 mg/disk (gentamicin) or 0.4 mg/disk (tobramycin), .

- Aminocyclitol antibiotics are similar to aminoglycosides structurally, but lack sugar groups bound to the rings.
- In this class apramycin and spectinomycin were investigated and both were found to be inactive at all concentrations tested.
- Chloramphenicol, in its own class, was only active down to 1.2 mg/disk.
- Results suggest that lincomycin & tylosin are effective against resistant AFB strains in the field in both Florida and New Jersey.
- **Ref. Jan Kochansky, David Knox, Mark Feldlaufer, Jeery Pettis. Screening alternative antibiotics against oxytetracycline-susceptible and -resistant Paenibacillus larvae. Apidologie, Springer Verlag, 2001, 32 (3), pp.215-222. <10.1051/apido:2001123>. <hal-00891688>**

European Foulbrood (EFB)

- ✓ A bacterial brood disease caused by *Streptococcus pluton*.
- ✓ It afflicts queen, drone, and worker larvae alike.
- ➢ Preventative antibiotic application:
- ✓ Time of application: Spring & fall.

The same procedure like AFB.

Chalkbrood

- ✓ a fungal brood disease caused by *Ascosphaera apis*.
- ✓ **Time of Treatment: Spring and fall .**
- ✓ No commercial treatment specifically targeting chalkbrood is currently available, but Apiguard has been shown to be used in Europe and USA.

Acarosis (The Honey Bee Tracheal Mite)

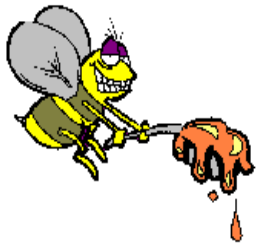
- ✓ Acarosis is caused by tracheal mite, *Acarapis woodi*.
- ✓ Time of Treatment: Spring and early summer.
- ✓ Spring treatment options:

1. Using 65% Formic acid.
2. Mite Away Quick Strip (MAQS): MAQS is a 7-day, single application mite control product registered for use against varroa and tracheal mites.
3. Re-queen your colonies with queens from known honey bee tracheal mite resistant stocks once every two years

Nosemosis (Nosema Disease)

- ✓ Nosema is caused by *Nosema apis and Nosema ceranae*. It is a microsporidian fungal disease that infects the intestinal tract of adult bees.
- ✓ **Time of Treatment: Spring**
- ✓ Spring Treatment using Fumagillin in 50% sugar syrup.
- ✓ Fall Treatment using Fumagillin in (2 sugar: 1 water) sugar syrup.
- ❖ The long residual life of fumagillin in honey has led to its being banned in some countries.
- ❖ Fumagillin suppresses reproduction of microsporidia but disease prevalence and hive performance in treated apiaries were similar to untreated apiaries.

- ❖ **Wei-Fone Huang,1,* Leellen F. Solter,1 Peter M. Yau,2 and Brian S. Imai2..Nosema ceranae Escapes Fumagillin Control in Honey Bees. PLoS Pathog. 2013 Mar; 9(3): e1003185.**



Honeybee Pests & Predators

- **Wax Moths (*Galleria mellonella & Achroia grisella).***
- **Wasps *(Vespa orientalis).***
- **Birds *(Merops apiater).***
- **Reptiles.**
- **Rodents**
- **Badger *(Mellivora capensis wilsoni).***
- **Ants *(Durylus fulvuse)..***


פוסטוקסין טבליות לאיוד
Phostoxin Flat Tablets for fumigation
فوستوكسين اقراص لاخراج الغازات
Aluminium Phosphide 56% (PH3)
חומר פעיל:
טבליות לאיוד להדברת חרקים בגרעיני תבואה
הפוסטוקסין קטלני לכל דרגות ההתפתחות (ביצים, זחלים, גלמים
וחרקים) של החרקים הבאים: זרעית מכותמת, זרעית השעועית, עש
הקמחונית, עש התבואה, עש הקמח, חיפושית הטבק, חיפושית
הקרנית האדומה, נגבר התבואה, עורית הגרגרים וארזית משוננת חזה.
יעילות עם הזנע הגדול הקטן בכוורות מאוחסנות וציר לעיתים רבים.
מסוכן מאוד (דרגה 6).
1397
4.3
קרא בעיון את התווית לפני השימוש
מיובא ומשווק על ידי
חן מרכז להדברה בעיר
DETIA DEGESCH GmbH

WASPS AND HORNETS

- **Aerosol Spray Pesticides.**

1. **Some sprays contain foaming agents that quickly expand to spread the lethal chemicals throughout the nest.**
2. **Others have ingredients that instantly freeze the insects.**
3. **Different insecticides contain various active ingredients, but many researchers recommends using a spray containing pyrethroids for the best results.**

- **Dust Insecticides, containing carbaryl or chlorpyrifos, and offer good wasp and hornet control.**
- **Wasps & Hornets are able to develop resistance to pyrethroid toxicity.**

Fipronil is a broad-use insecticide that belongs to the phenylpyrazole chemical family.


EURO WASP CATCHER
EURO WASP CATCHER


REPEL
WASP
HORNET
KILLS ON CONTACT
ELIMINATES THE NEST


Safer
EASY • EFFECTIVE • GUARANTEED
ALL NEW!
DELUXE YELLOWJACKET/WASP
TRAP
Unconditionally Guaranteed. Made in China.


Rentokil
WASP TRAP
2
Attracts and kills wasps
Free standing or can be hung up
Strong, discreet, easy to fill and cle
Part of our safer, poison-free range

Avoiding Resistance

To delay the development and spread of resistance beekeepers should:

1. Use an integrated approach .
2. Use recommended application rates.
3. Rotate unrelated compounds
4. Use mixtures with caution.
5. Make sure that coverage is achieved.
6. Monitor problematic pests.

References

1. **Beekeeping in Israel (2012).**
2. **FAO.(2012). International Code of Conduct on the Distribution and Use of Pesticides. Guidelines on Prevention and Management of Pesticide Resistance.pp.57.**
3. **Jan Kochansky, David Knox, Mark Feldlaufer, Jeery Pettis (2001). Screening alternative antibiotics against oxytetracycline-susceptible and -resistant Paenibacillus larvae. Apidologie, Springer Verlag,:32 (3), pp.215-222. <10.1051/apido:2001123>. <hal-00891688>.**
4. **The Animal and Plant Health Agency (2015).Managing Varroa.,National Agri-Food Innovation Campus,Sand Hutton.UK.**
5. **WeiFone Huang, Leellen F. Solter, Peter M. Yau, and Brian S. Imai.(2013). Nosema ceranae Escapes Fumagillin Control in Honey Bees.PLoS Pathog. 2013 Mar; 9(3): e1003185.**

Thank You!