Recent advances in Bee Breeding and Management

- The situation
- A varroa model
- Simplified breeding
- Midsummer mite control

Randy Oliver
ScientificBeekeeping.com

Our methods have changed little since 1890.

But beekeeping used to be much simpler.


PROBLEM #1
VARROA/DWV

The catastrophe of varroa

Beekeeping suddenly became much more difficult.

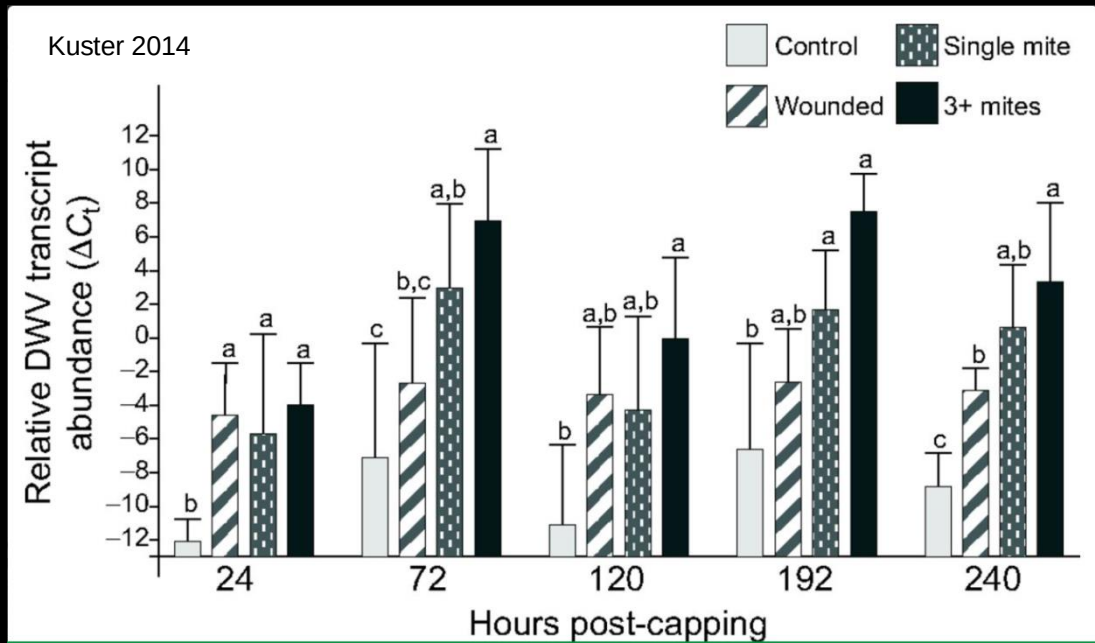

The mite…
acts as a vector of…
Deformed Wing Virus

A mutualistic symbiotic relationship

← *Varroa benefits*

DWV benefits →

Both species benefit from better reproduction and dispersal.



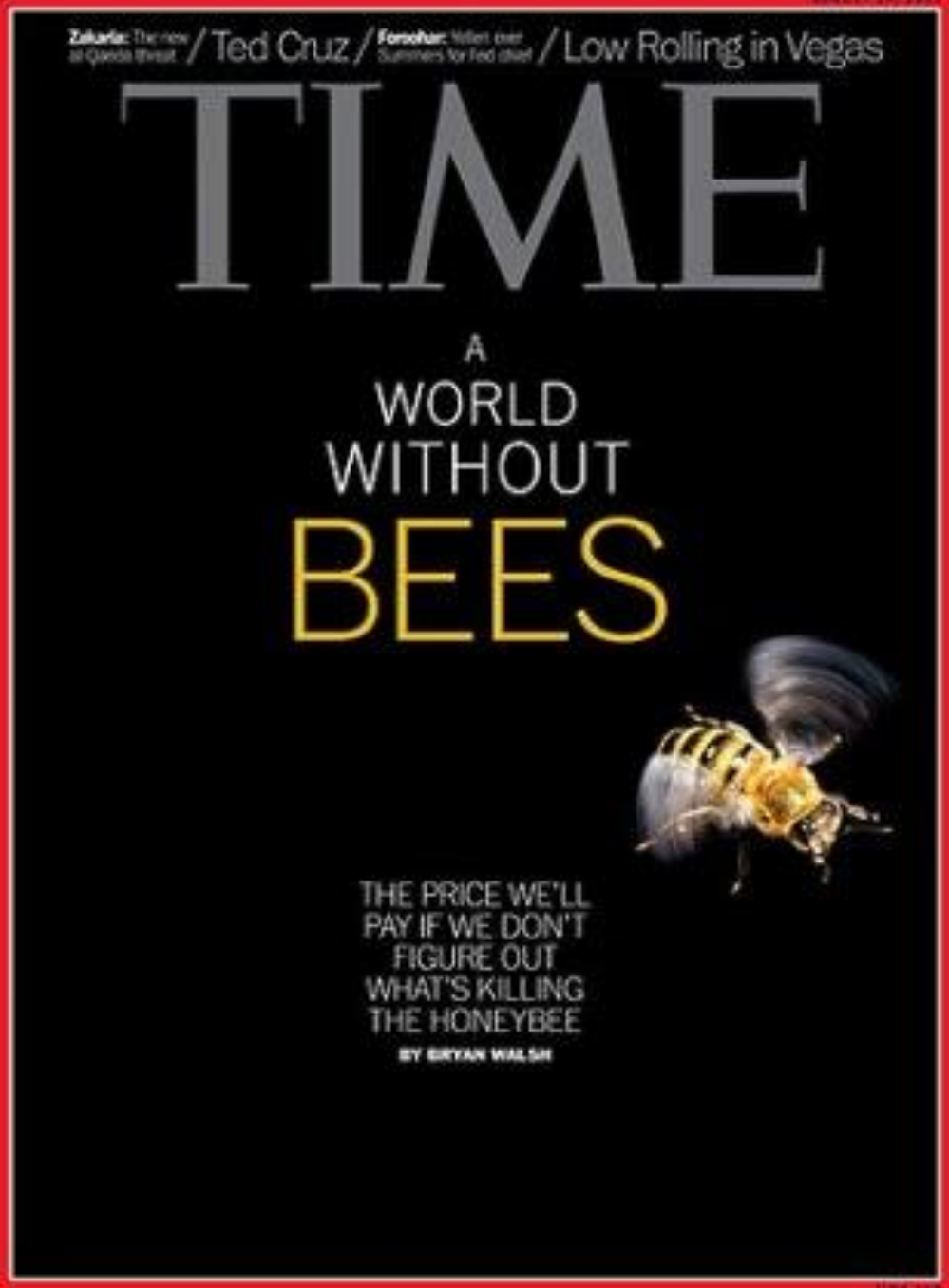

The two parasites collaborate to cause the collapse of the colony in late summer

Think of every collapsing hive as being a giant sneeze of virus-transmitting bees and mites.

We are creating a two-headed monster of our own making.


PROBLEM #2
MISINFORMATION


What’s up with all the talk about bees going extinct?



Sensationalism, not facts, sells copy.

Honey bees are not in any way threatened with extinction.

The press has gotten many things wrong.

Pesticides and Honey Bees:

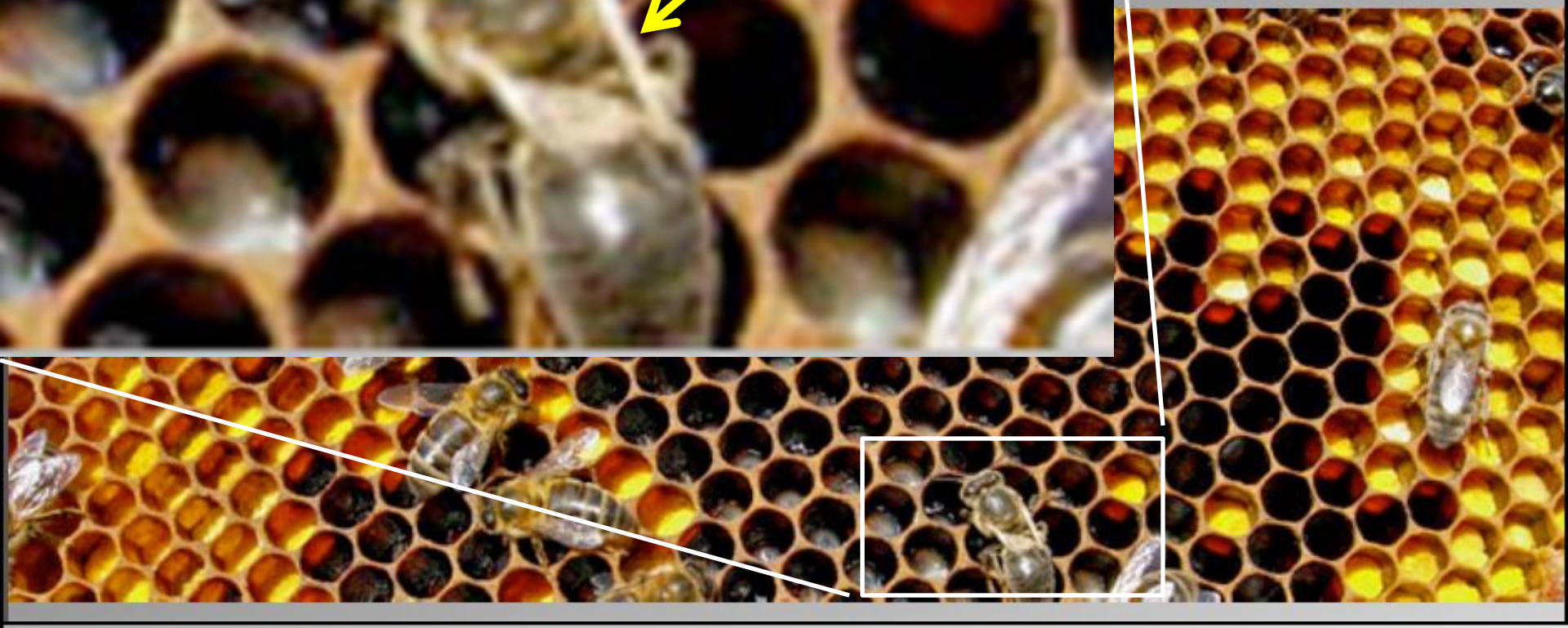
State of the Science

"The weight of evidence demonstrates that **pesticides** are indeed key in explaining honey bee declines…"

MAY 2012

PESTICIDE ACTION NETWORK NORTH AMERICA

ey Bees:
e Science

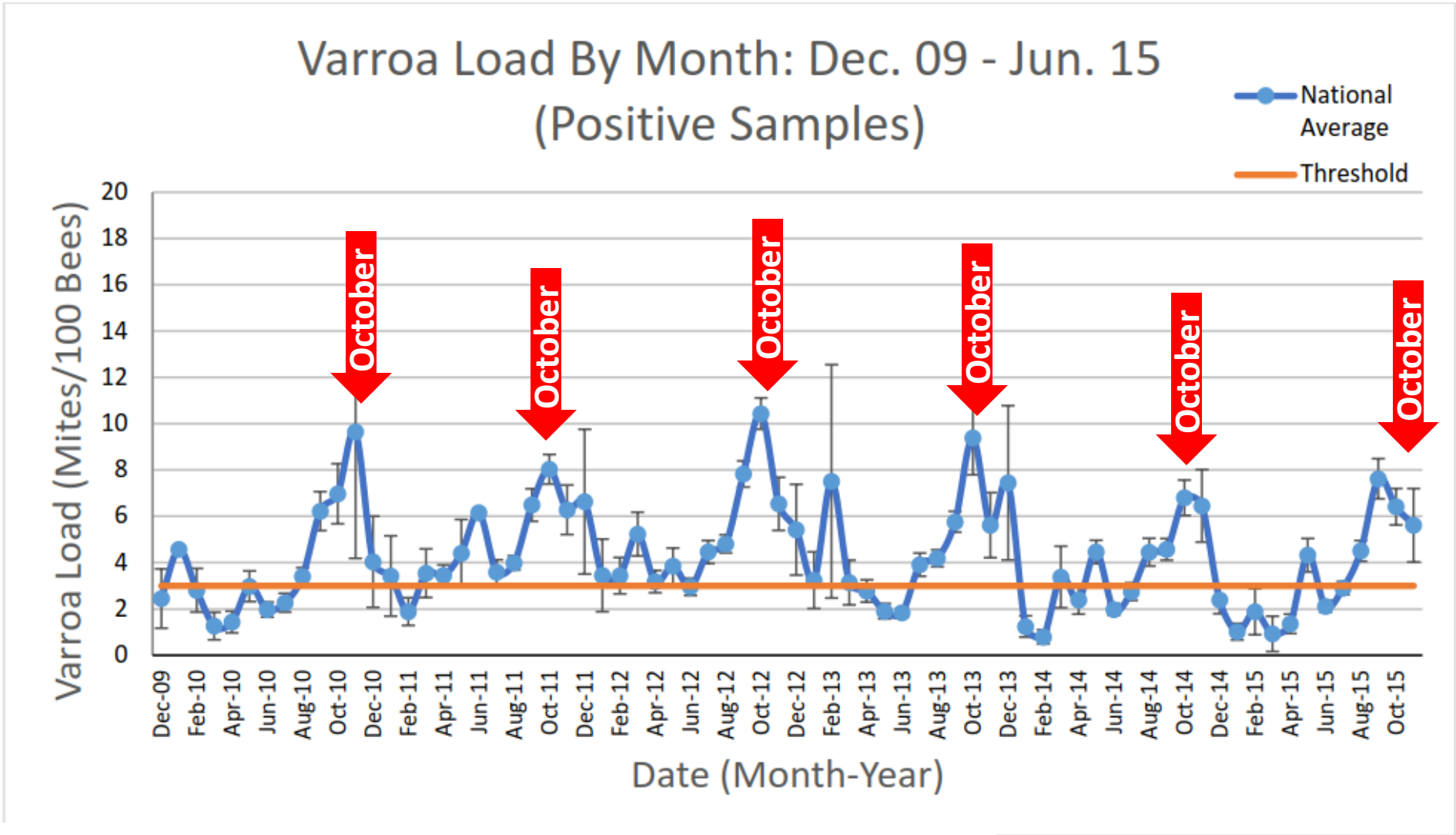


MAY 2012

PESTICIDE ACTION NETWORK NORTH AMERICA


PROBLEM #3
INADEQUATE
VARROA
MANAGEMENT

Mite management fact: wishful thinking doesn't work



2014 – 2015 National Honey Bee Disease Survey Report

U.S. beekeepers are not adequately managing varroa!

Approximately 60% of recreational beekeepers do not manage varroa.

Their misguided idealism can be a disaster to the bee population and perhaps all pollinators.

Growers who don't manage their pests affect all surrounding growers.

The Rules of Organic Beekeeping

Formal Recommendation by the
National Organic Standards Board (NOSB)
to the National Organic Program (NOP)

"The producer must not accept the presence of pests, parasites, or disease without initiating efforts to restore the health of the colony."

This puppy is suffering from a mite infestation


Responsible
Beekeeping

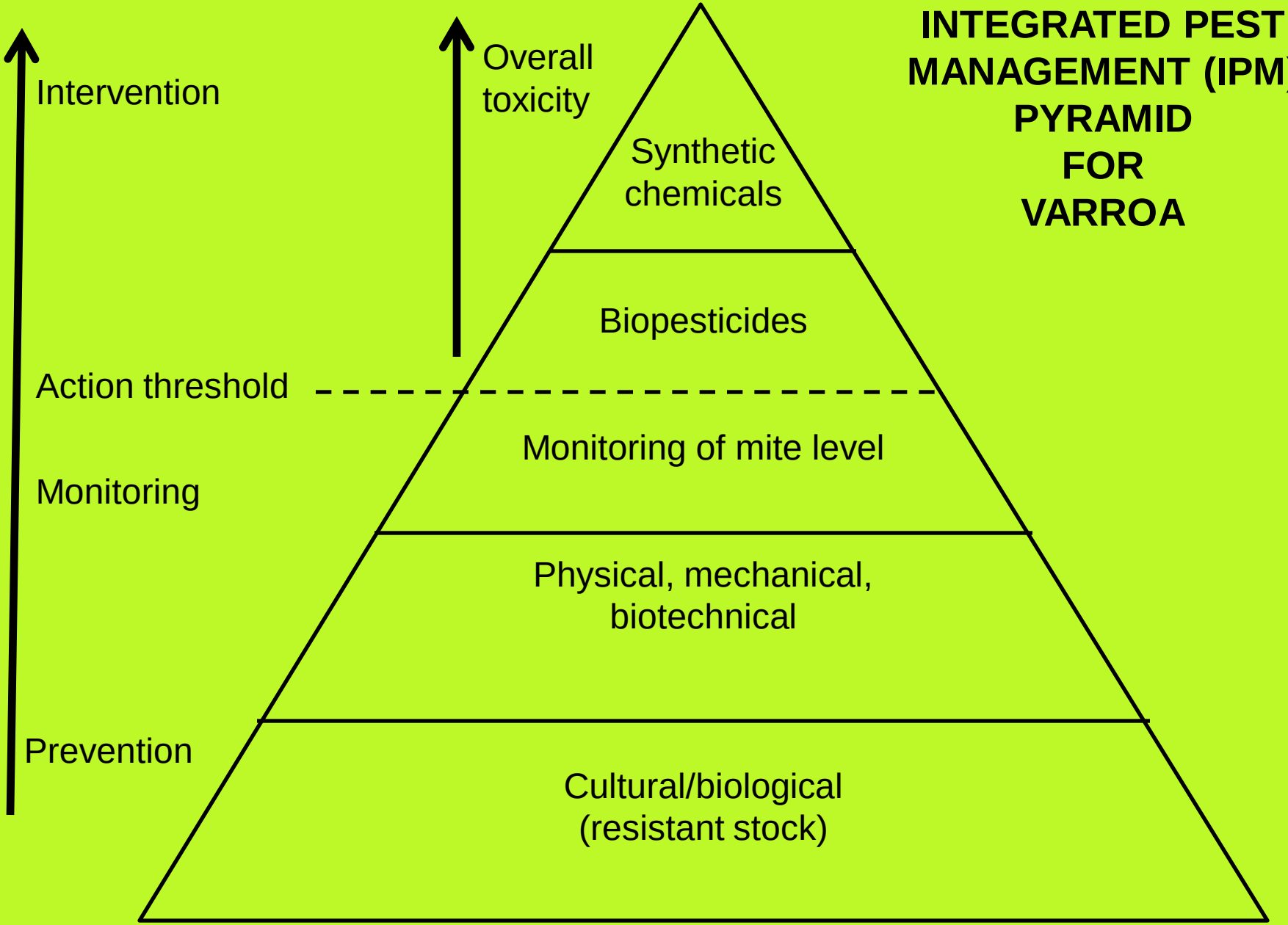
Healthy bees are a community issue—learn to recognize AFB and out-of-control varroa.


AFB


Parasitic mite syndrome
This colony is about to collapse.


PROBLEM #4
THE SYNTHETIC
MITICIDES

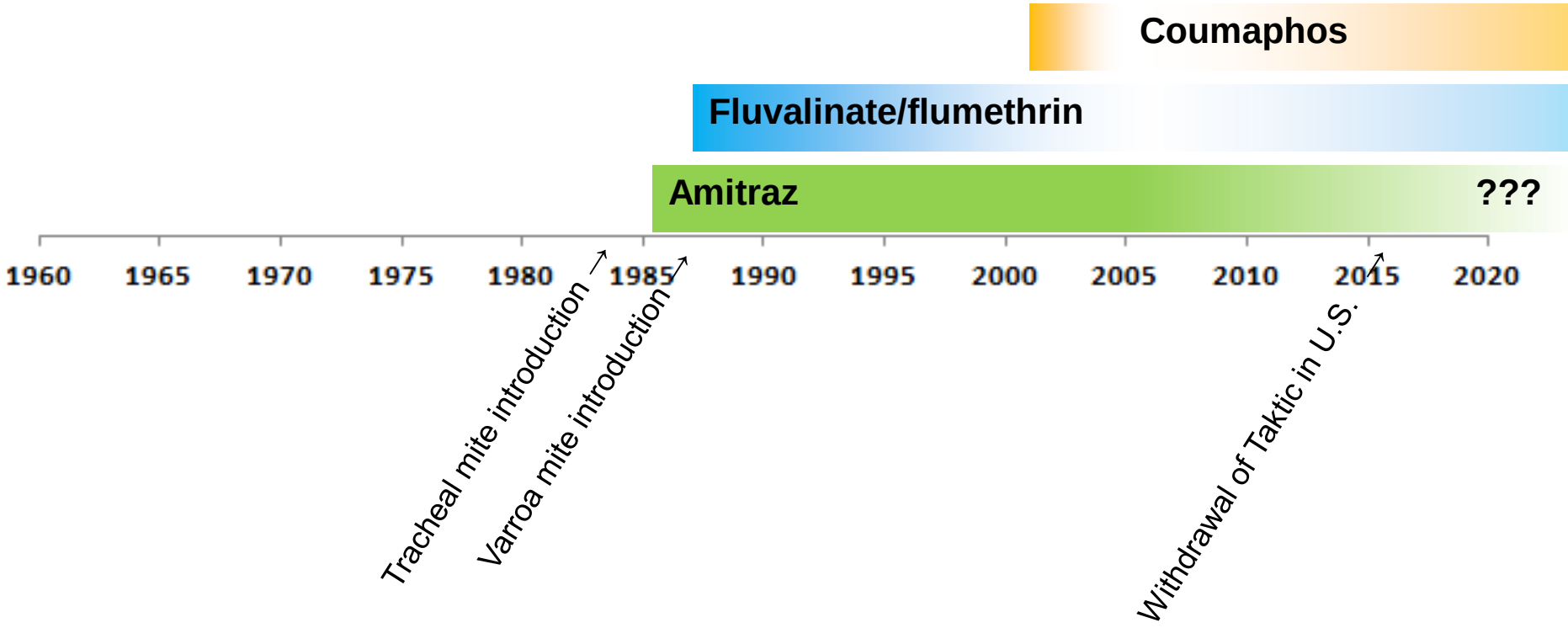
INTEGRATED PEST MANAGEMENT (IPM) PYRAMID FOR VARROA



Most countries skipped straight to synthetic chemistry.

The Silver Bullet—
Beekeeping became easy again!

Miticide failure in the U.S.



We keep making the same mistake…

Table 1. Summary of pesticide detections in wax samples from North American honey bee colonies.

Wax Pesticide*	Class#	Detects	Samples Analyzed	%	Detections (ppb) High	Low	Median	90%tile	95%tile	Mean
Fluvalinate	PYR	254	259	98.1	204000.0	2.0	3595.0			
Coumaphos	OP	254	259	98.1	91900.0	1.0	1240.0			
Coumaphos oxon	OP	187	208	89.9	1300.0	1.3	56.1			
Chlorpyrifos	OP	163	258	63.2	890.0	1.0	4.3			
Chlorothalonil	FUNG	127	258	49.2	53700.0	1.0	91.4			
DMPF (amitraz)	FORM	107	177	60.5	43000.0	9.2	228.0			
Endosulfan I	CYC	97	258	37.6	95.0	1.2	4.1			
Endosulfan II	CYC	65	258	25.2	39.0	1.1	3.8			
DMA (amitraz)	FORM	60	177	33.9	3820.0	120.0	437.0			
Pendimethalin	HERB	49	176	27.8	84.0	2.5	6.1			
Fenpropathrin	PYR	44	258	17.1	200.0	1.3	14.3			
Esfenvalerate	PYR	43	258	16.7	56.1	1.0	4.5			
Azoxystrobin	S FUNG	40	258	15.5	278.0	1.0	5.7			
Methoxyfenozide	IGR	39	208	18.8	495.0	3.5	42.3			
Bifenthrin	PYR	33	258	12.8	56.1	1.5	5.3			
Endosulfan sulfate	CYC	29	258	11.2	33.0	1.3	3.0			
Atrazine	S HERB	29	208	13.9	31.0	1.0	5.5			
Dicofol	OC	26	258	10.1	21.0	1.5	5.1			
Aldicarb sulfoxide	S CARB	22	208	10.6	649.0	13.4	298.5			
Trifluralin	HERB	22	176	12.5	36.0	1.0	1.4			
Boscalid	S FUNG	21	208	10.1	388.0	16.9	84.0			
Carbendazim	S FUNG									
Oxyfluorfen	HERB									
Methidathion	OP									
Aldicarb sulfone	S CARB									
Iprodione	FUNG									

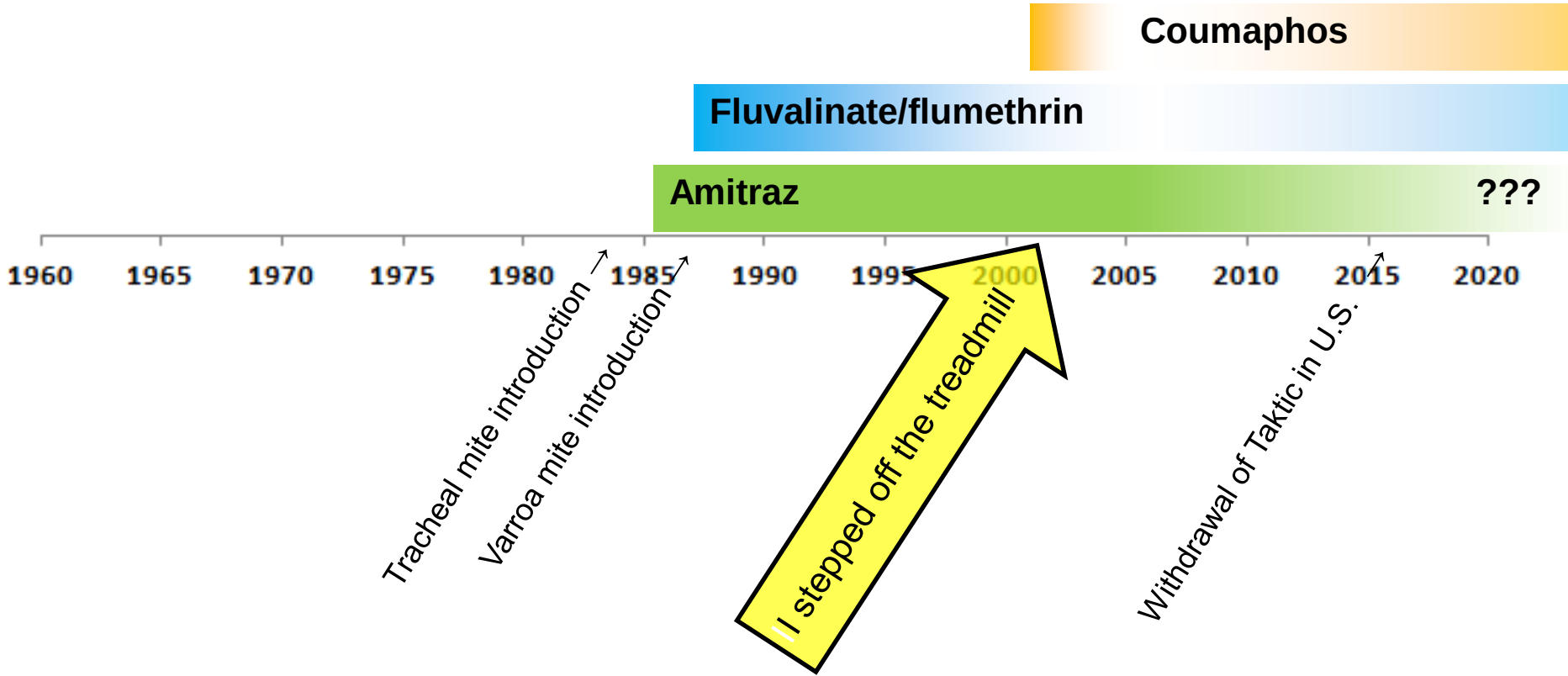
Impacts of beekeeper-applied miticides

High Levels of Miticides and Agrochemicals in North American Apiaries: Implications for Honey Bee Health

Christopher A. Mullin[1]*, Maryann Frazier[1], James L. Frazier[1], Sara Ashcraft[1], Roger Simonds[2], Dennis vanEngelsdorp[3], Jeffery S. Pettis[4]


A Solution:
Practice better bee husbandry

Can we do it without synthetic miticides?

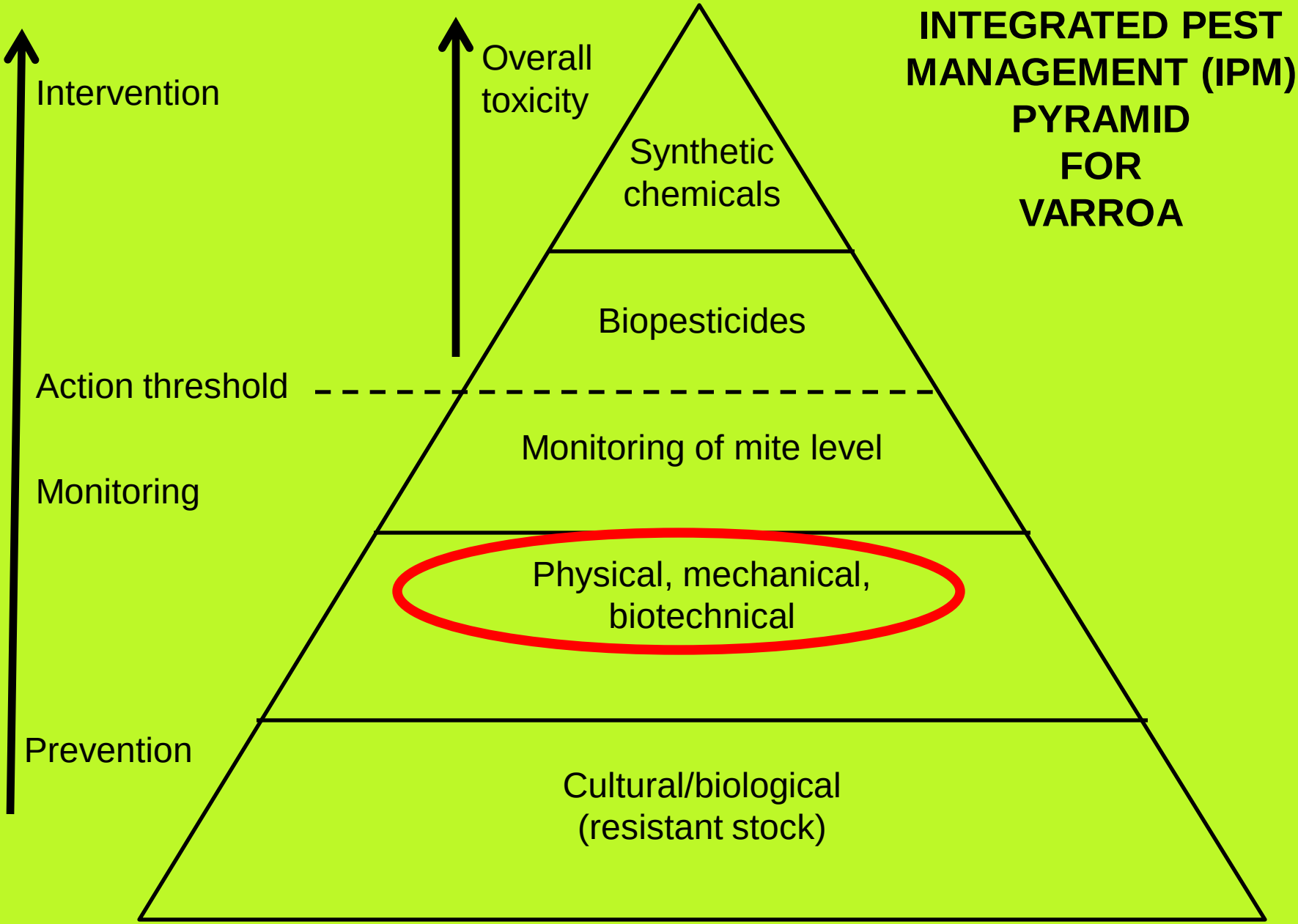


Walkin' the walk

No synthetic miticides since the year 2001.

We use only organically-approved mite control methods.

1600 hives.
Low winter losses.
Strong hives to almonds.
Sell 1000 nucs/yr.


INTEGRATED PEST MANAGEMENT (IPM) PYRAMID FOR VARROA
Intervention
Overall toxicity
Synthetic chemicals
Biopesticides
Action threshold
Monitoring of mite level
Monitoring
Physical, mechanical, biotechnical
Prevention
Cultural/biological (resistant stock)


Watch the pollen

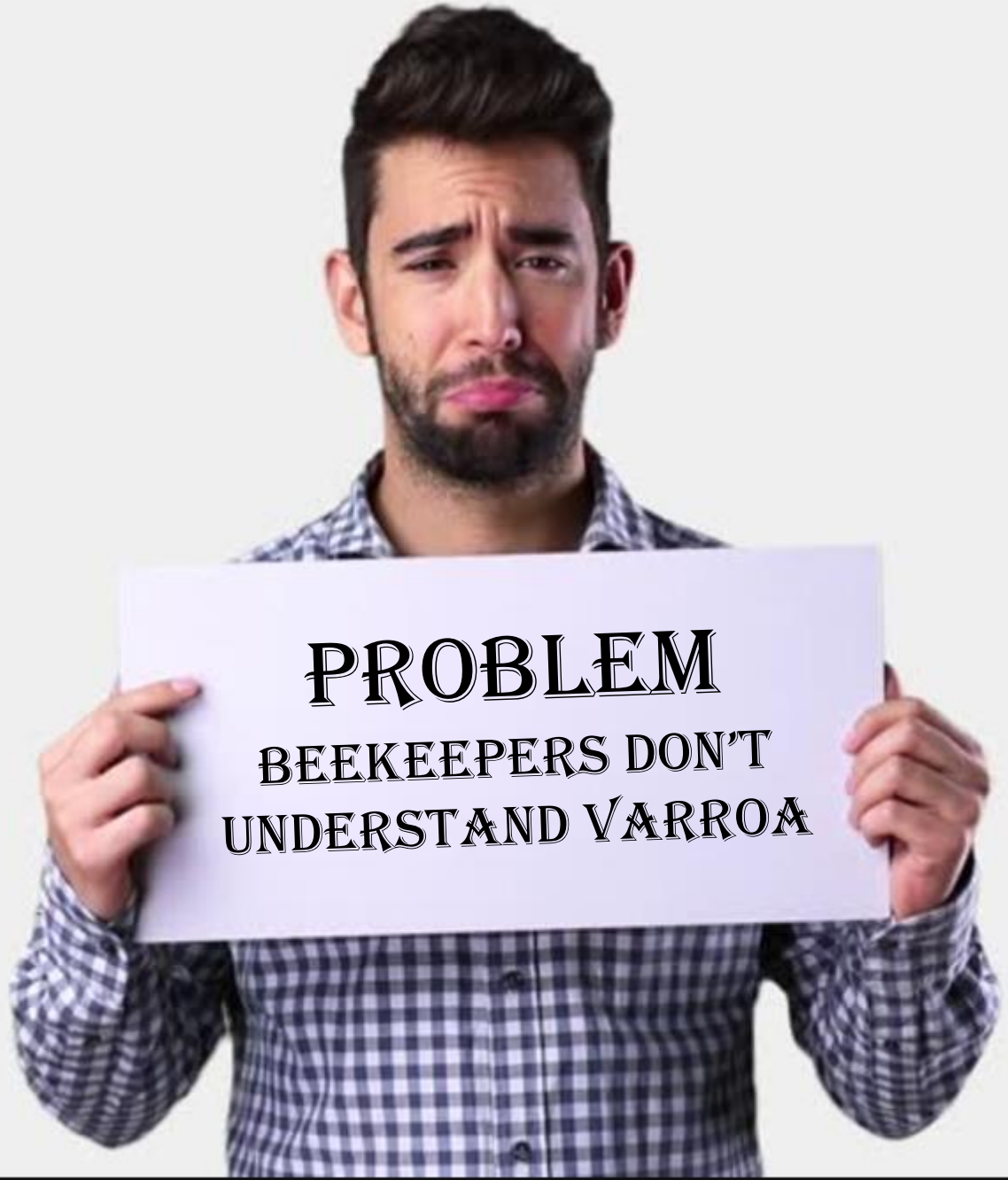
We feed protein patty during pollen dearths


Rust fungus
spores

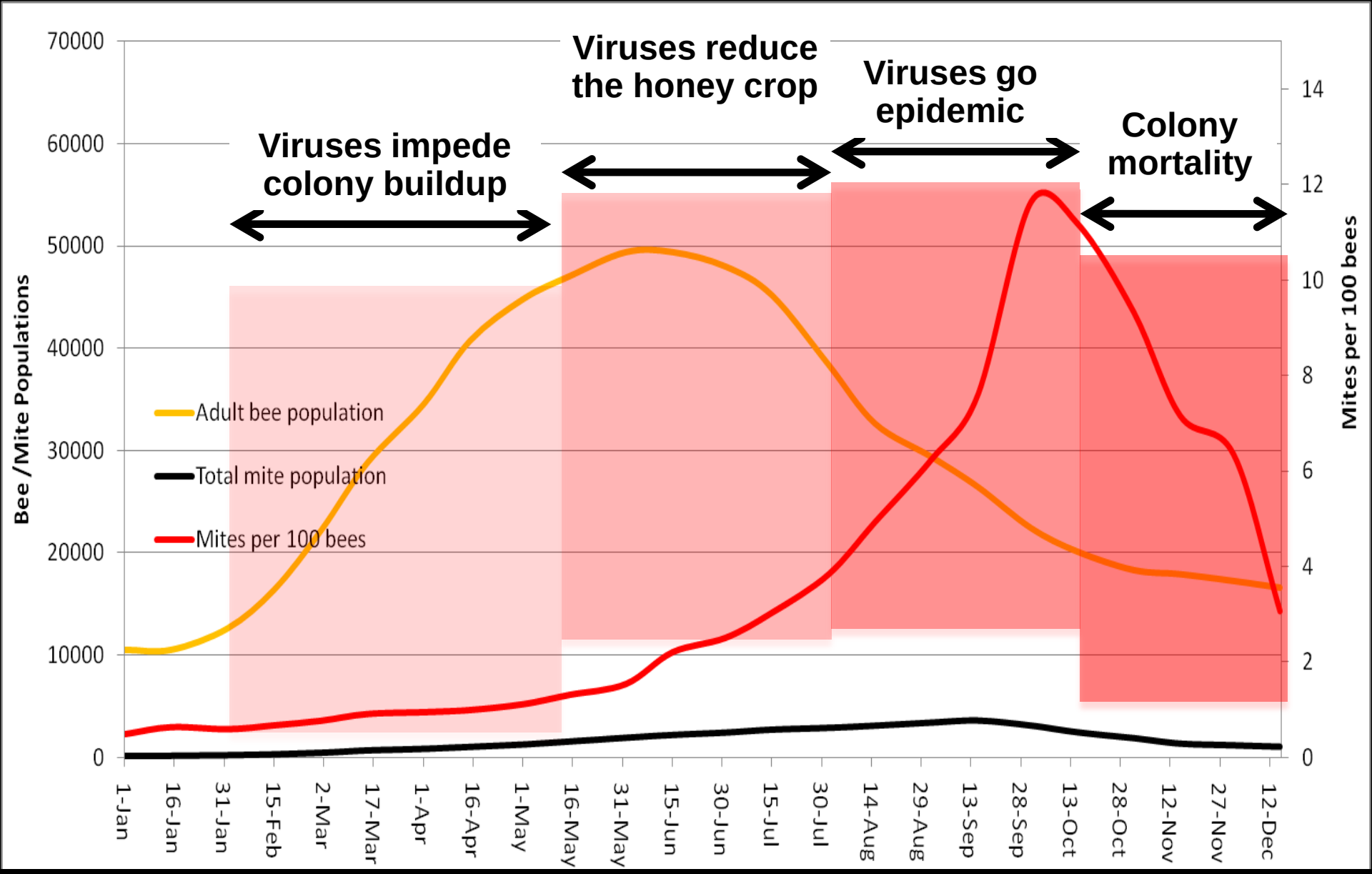
Drone trap frames

Help, but only a 15-20% mite reduction

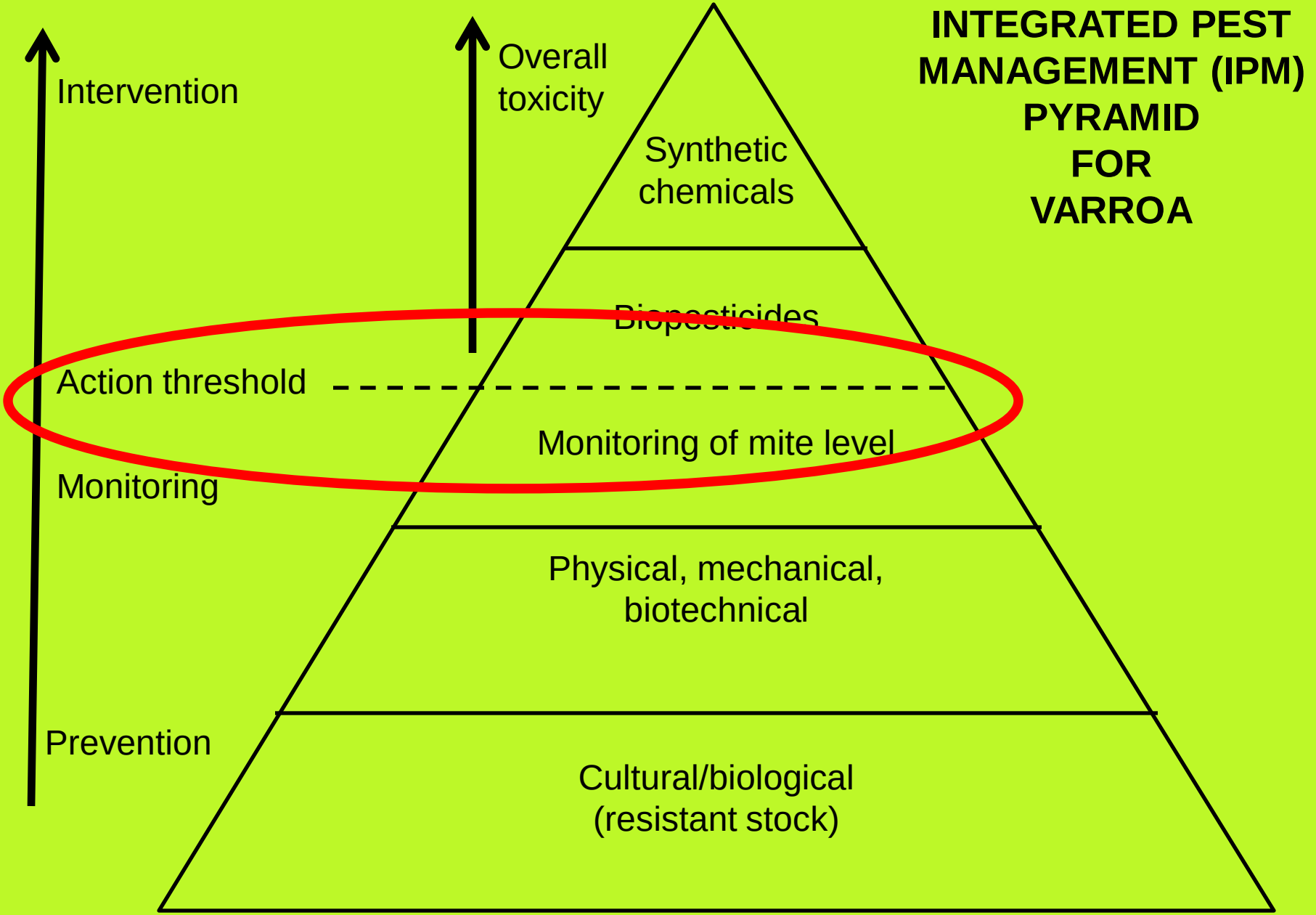

Powdered Sugar Dusting:
Can work, but generally impractical


PROBLEM
BEEKEEPERS DON'T
UNDERSTAND VARROA


VARROA MANAGEMENT =
VECTOR MANAGEMENT



Healthy hives require low mite levels
all season long.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Overall toxicity
Synthetic chemicals
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Action threshold
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Monitoring
Physical, mechanical, biotechnical
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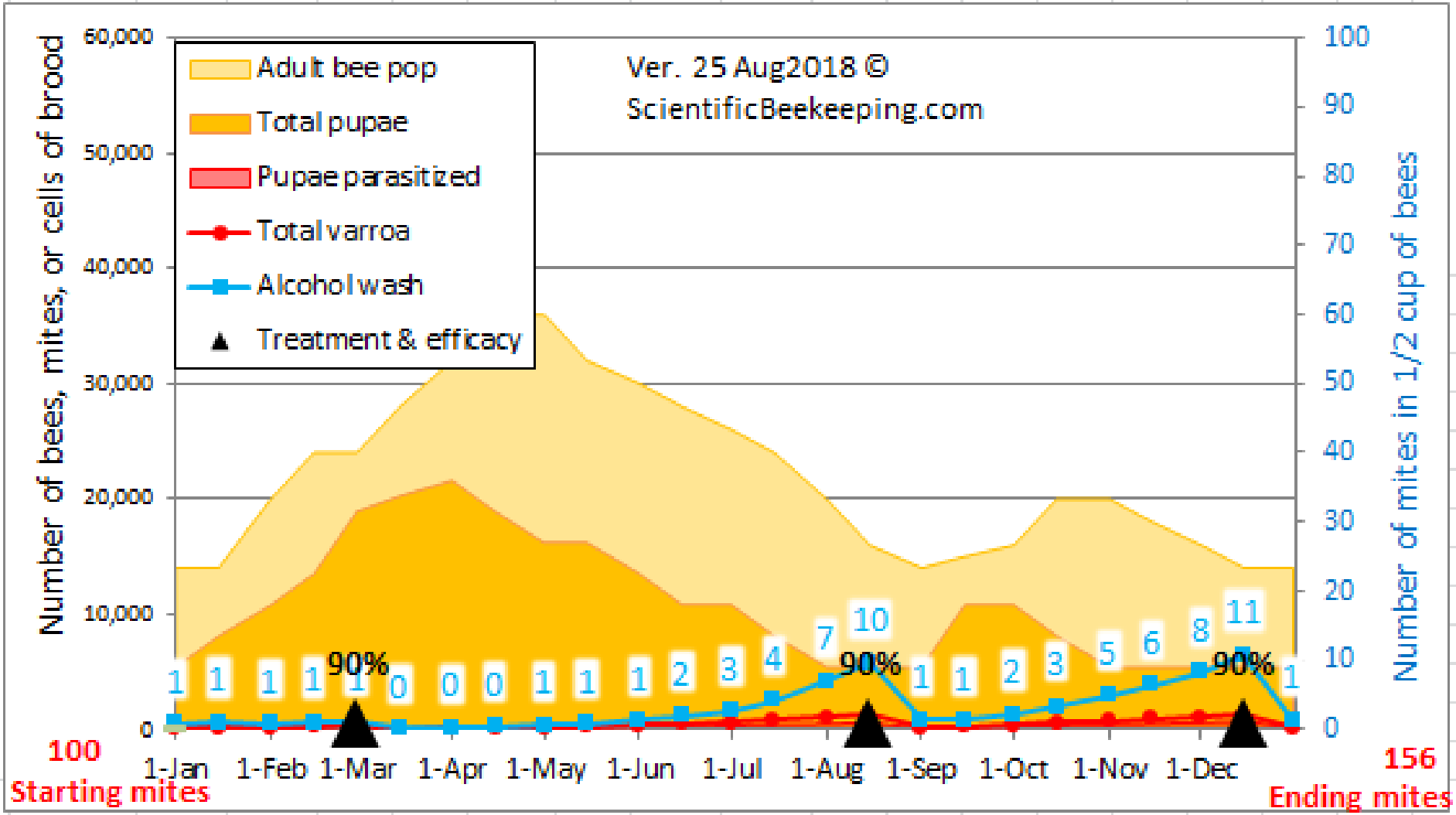
Cultural/biological (resistant stock)


A Solution:
An interactive model



A: Subtropical colony, dry climate; no winter brood break--Southern California

Understand mite population dynamics.

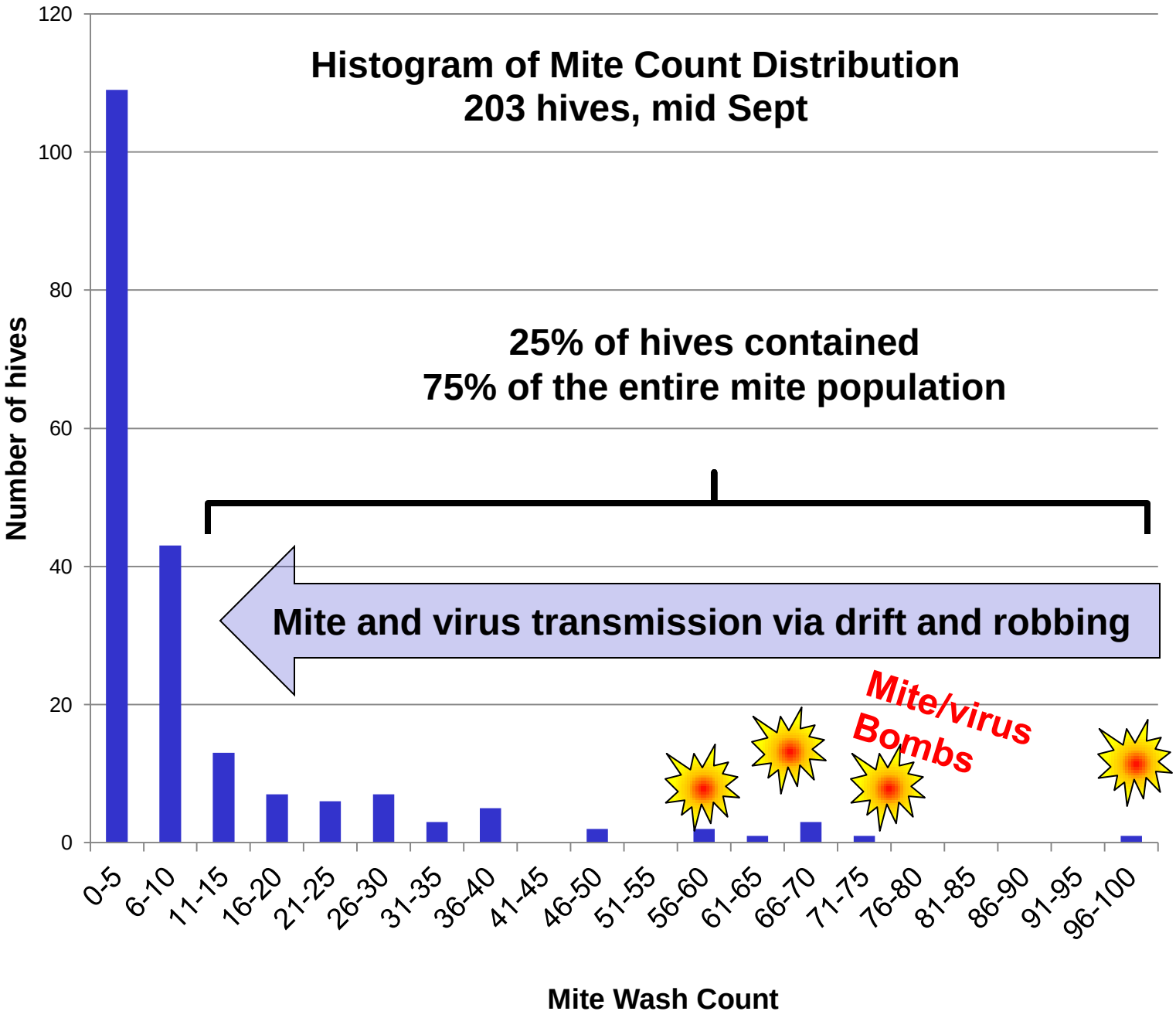
Search "Randy's varroa model"

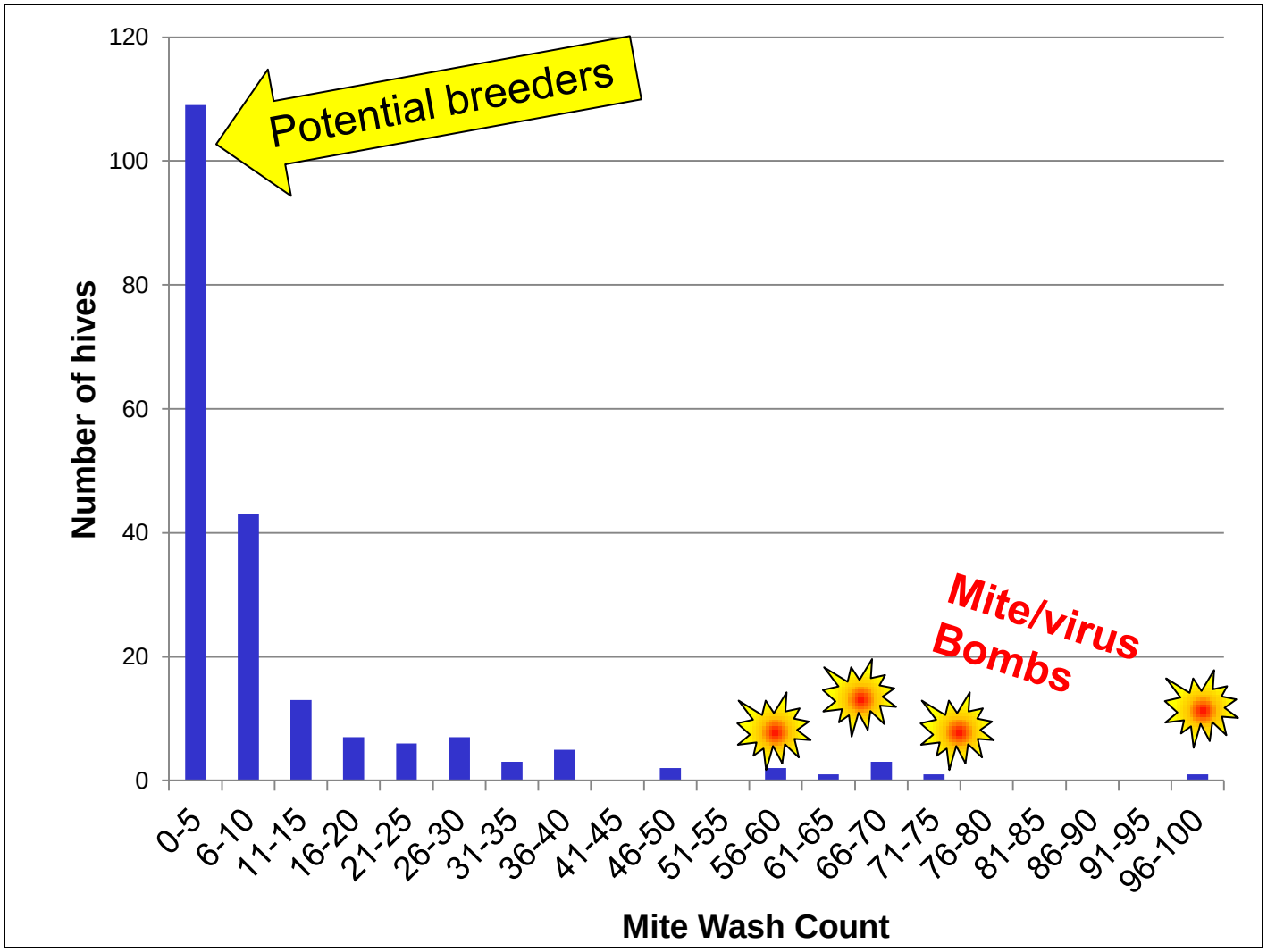
The alcohol swirl is quickest & most accurate

Show video

Randy mite wash video 2018

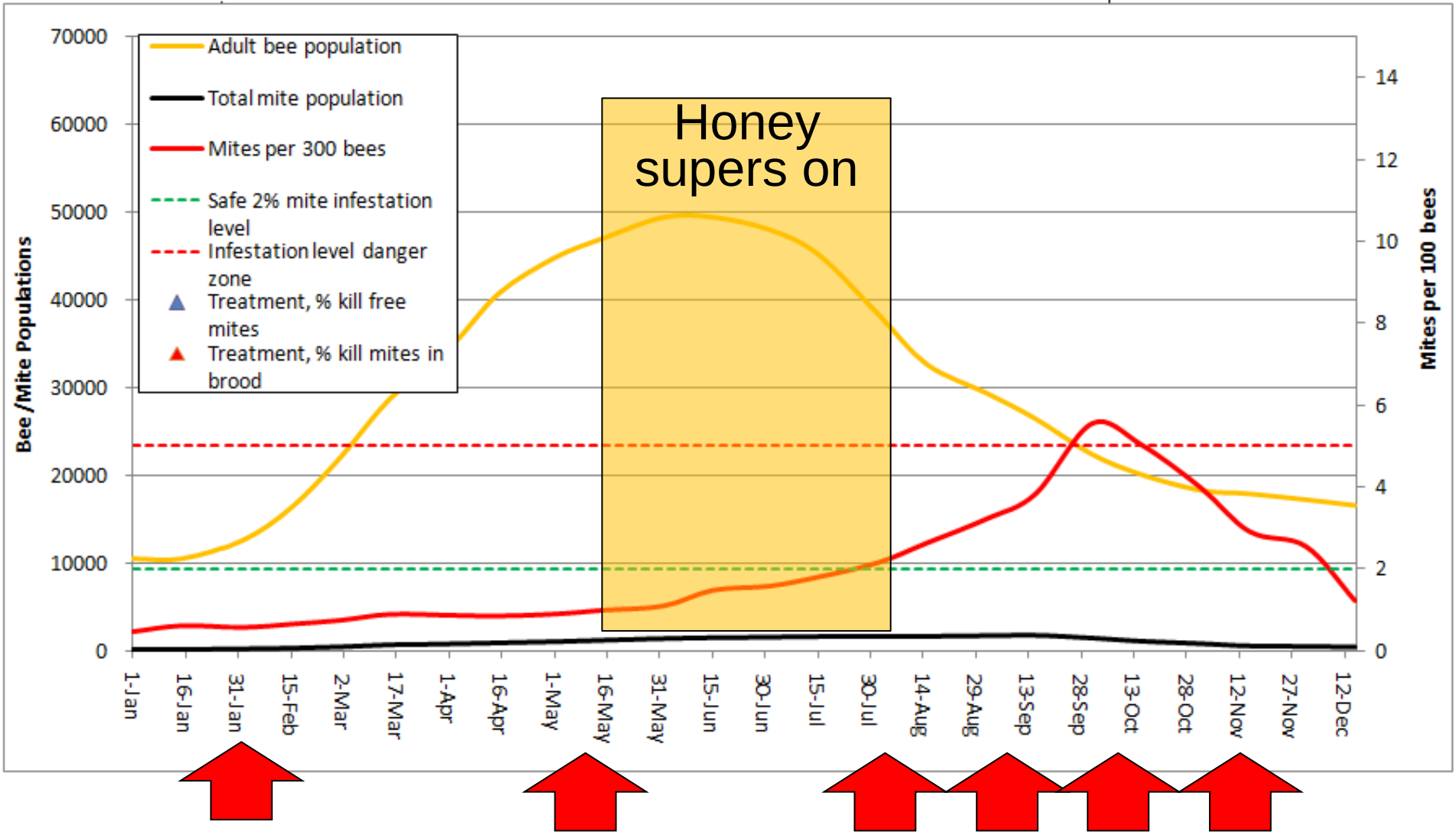
0:01:29


Histogram of Mite Count Distribution
203 hives, mid Sept
25% of hives contained
75% of the entire mite population
Mite and virus transmission via drift and robbing
Mite/virus Bombs
Number of hives
Mite Wash Count
120
100
80
60
40
20
0
0-5
6-10
11-15
16-20
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60
61-65
66-70
71-75
76-80
81-85
86-90
91-95
96-100



Sample enough hives to identify the bombs.

Mark, treat, requeen, and monitor the high-mite hives.

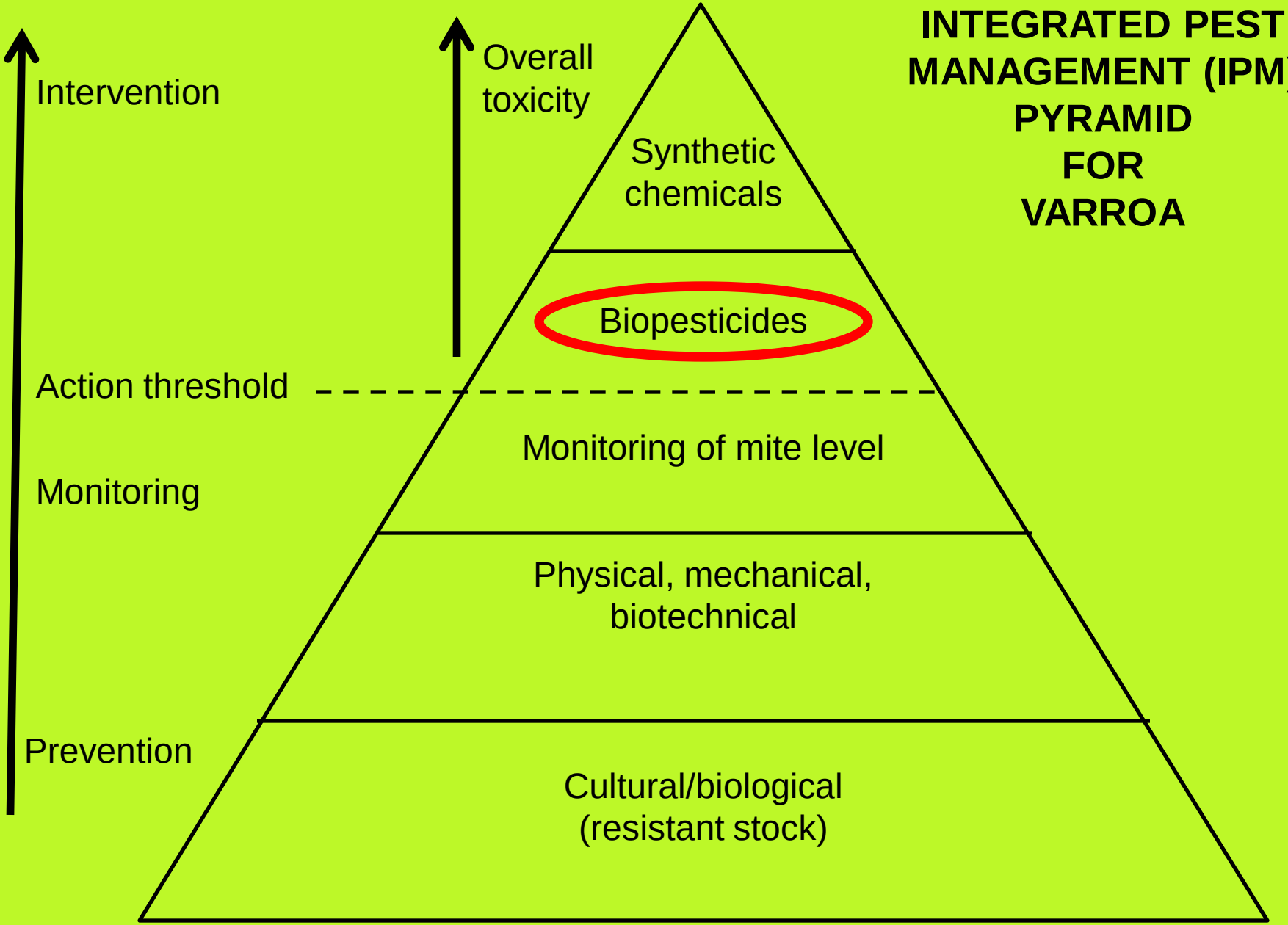


Times to monitor


PROBLEM
BEEKEEPERS DON'T
WANT TO "TREAT"


A Solution:
There are effective
organic treatments

INTEGRATED PEST MANAGEMENT (IPM) PYRAMID FOR VARROA




Organic varroa
treatments

Apiguard® thymol gel

Very effective
August treatment


MAQS formic acid
Zero residues.
Use caution in hot weather!

Oxalic acid dribble or vapor—fall treatment or with induced brood break

Swarm (and mite) control

Queen cell

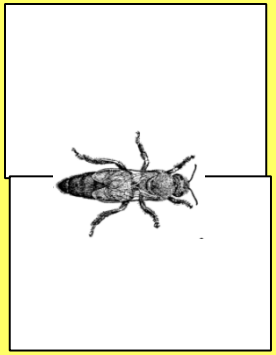
Young bees, sealed brood & queen cell

Split strong colony <u>before</u> it swarms

Queenless split

On new stand, young bees, queen cell and <u>all</u> sealed brood. Oxalic acid dribble or vapor 19 days later.

Option: If you don't want to make increase, recombine after swarm season—pinch old queen or let bees choose.



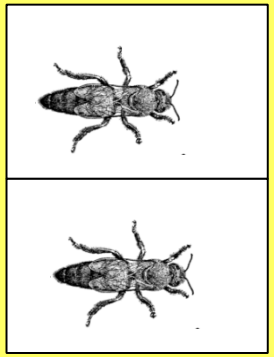
Strong colony about to swarm

Queenright split

Additional room

open brood

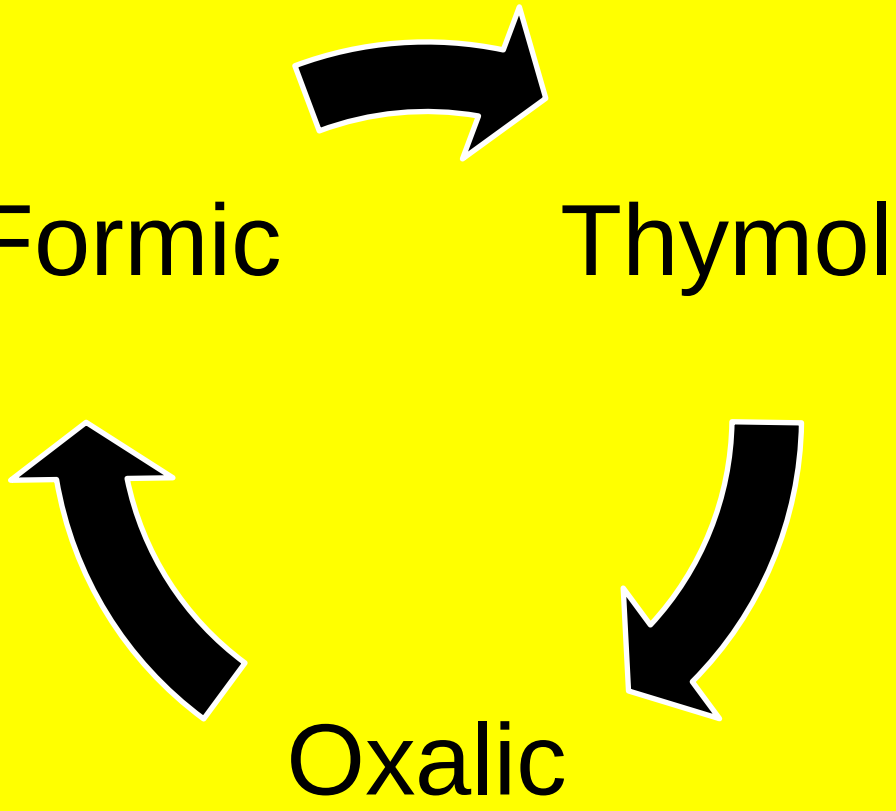
Super



Old queen and open brood remain on original stand. Oxalic dribble or vapor at splitting.


Hopguard II
Effective when no brood.
A promising product, but needs work.

Practice some sort of rotation of treatments



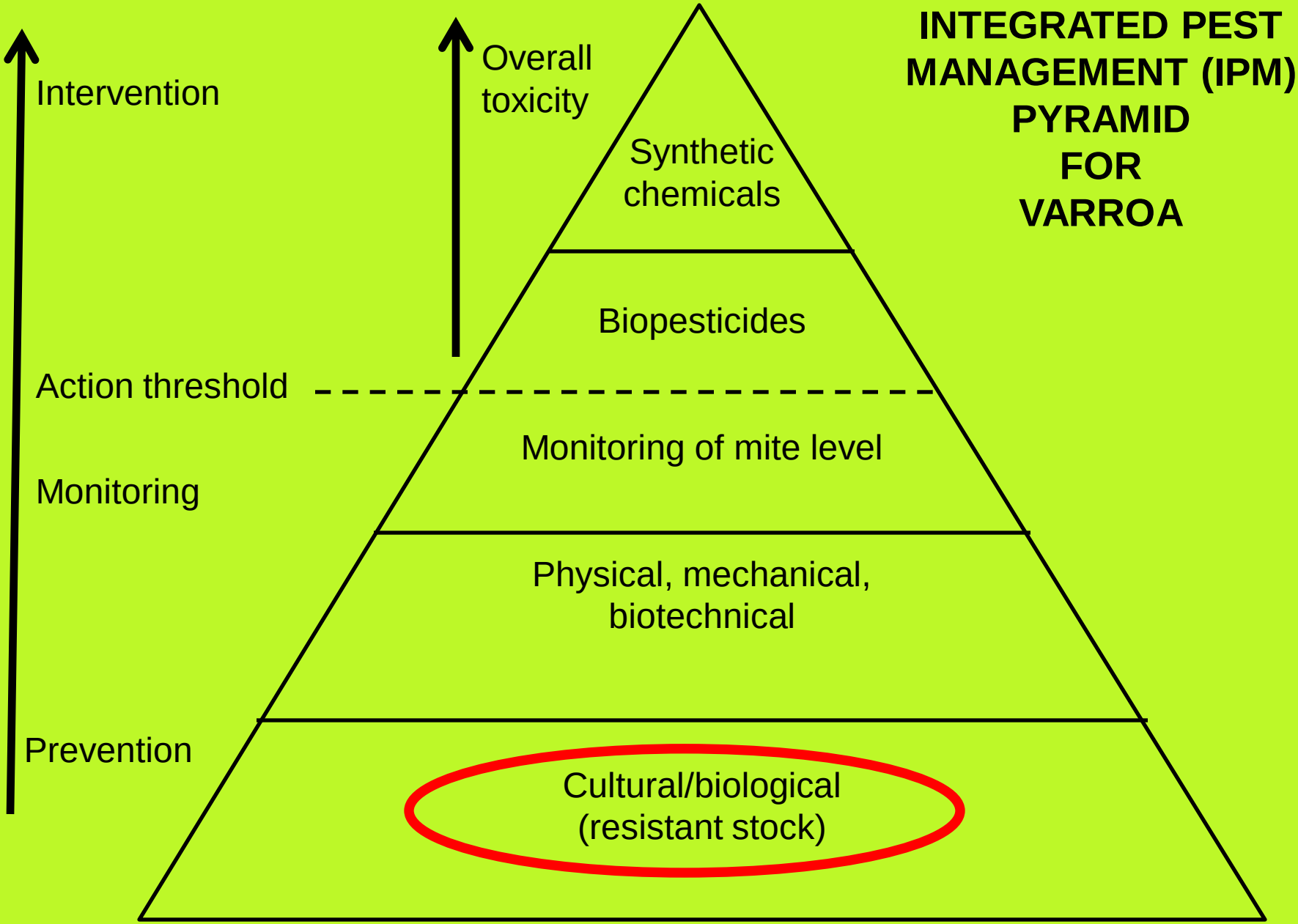

PROBLEM
COMMERCIAL BEE STOCK
IS NOT MITE RESISTANT

Our current breeds of bees, bred for production

(a.k.a. “mite candy”)

require regular treatments to survive.


The Long-Term Solution:
Breeding mite-resistant bees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Intervention
Overall toxicity
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Monitoring
Physical, mechanical, biotechnical
Prevention
Cultural/biological (resistant stock)

GRASS ROOTS
FARMERS' COOPERATIVE

Livestock Husbandry Standards and Best Practices

2.3 Parasites

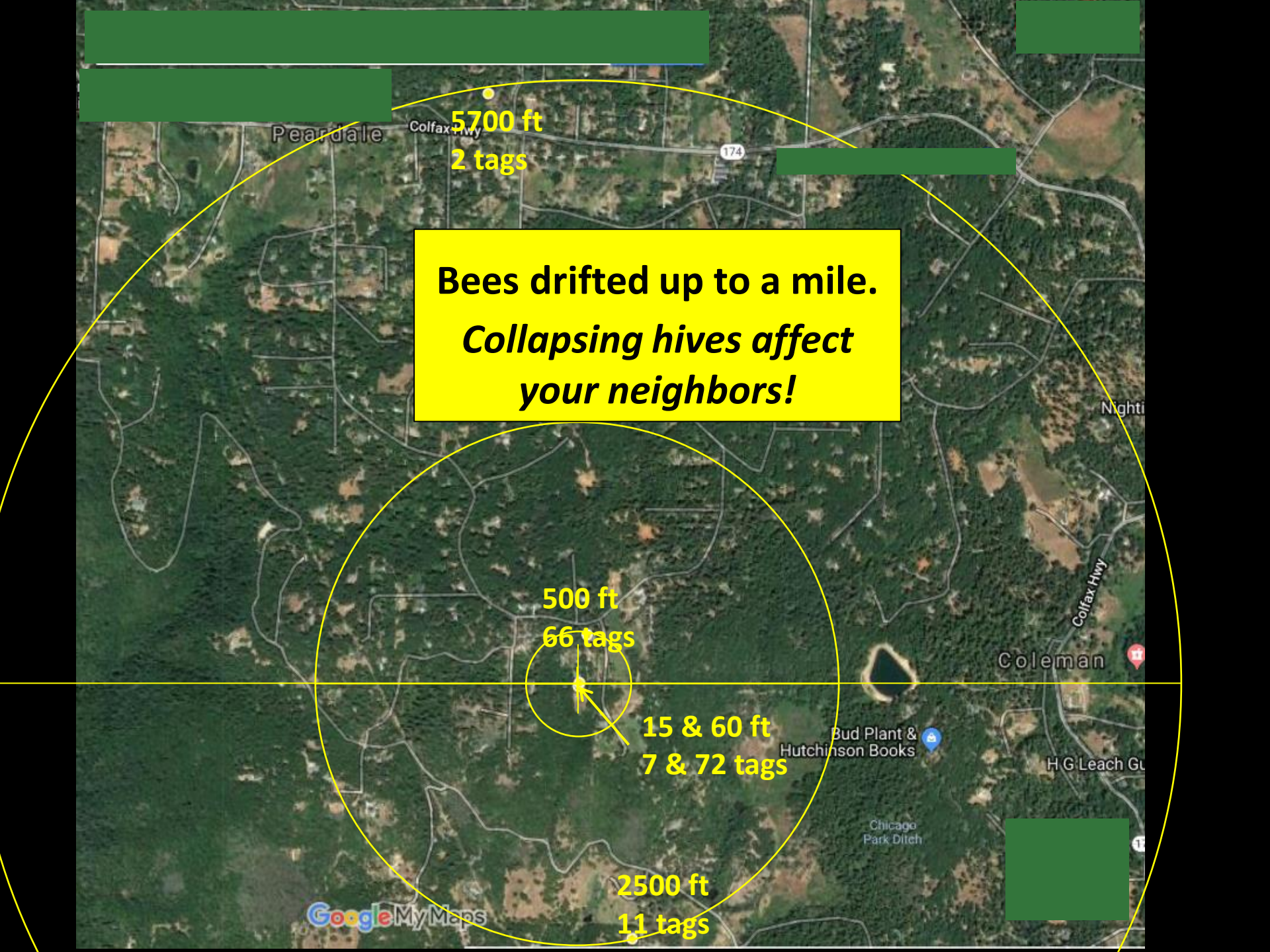
…If prevention is not effective, treatment must be implemented to effectively control worms, lice, mites, flies and other internal and external parasites …

Farmers **must develop a management plan to increase the livestock's resistance and/or resilience to parasites** over time.

Dr. John Kefuss in France—the "Bond Method."
It's also worked in Africa and elsewhere.
But involved high colony losses,
and can hurt your neighbors.


2018 project to quantify bee and mite drift—6000 tagged bees


½ mile
Magnetic retrieval


5700 ft
2 tags
Bees drifted up to a mile.
Collapsing hives affect your neighbors!
500 ft
66 tags
15 & 60 ft
7 & 72 tags
2500 ft
11 tags
Peardale
Colfax Hwy
174
Coleman
Colfax Hwy
Bud Plant & Hutchinson Books
Chicago Park Ditch
Google My Maps

Bee Responsible

What happens in your hives affects <u>all</u> pollinators!

Drifted mites can overwhelm even resistant colonies and cause the loss of promising genetics.

A SIMPLIFIED SELECTIVE BREEDING PROGRAM

Just define the job description…

and eliminate the genes of those that don’t perform to your specifications.

BE REALISTIC

Commercial package bees will die without treatment.

They will not become resistant

just because you want them to!

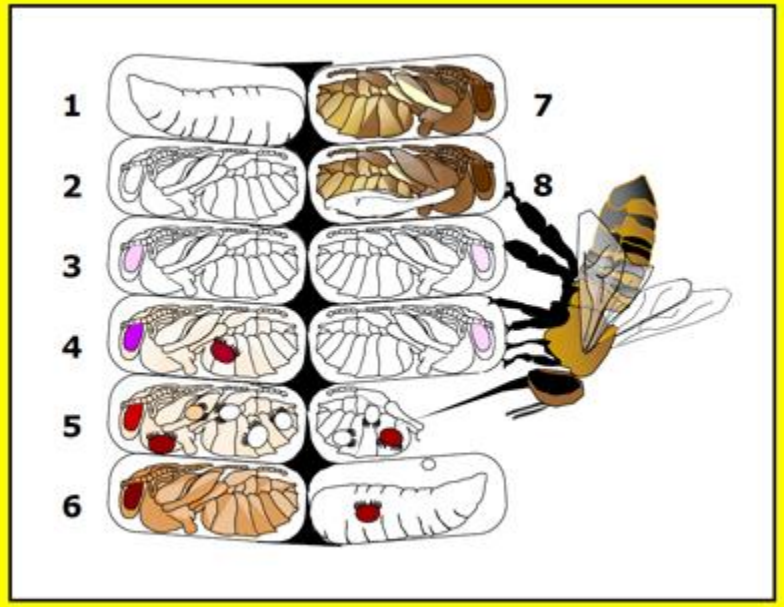
START WITH BEES THAT AT LEAST HAVE A FIGHTING CHANCE

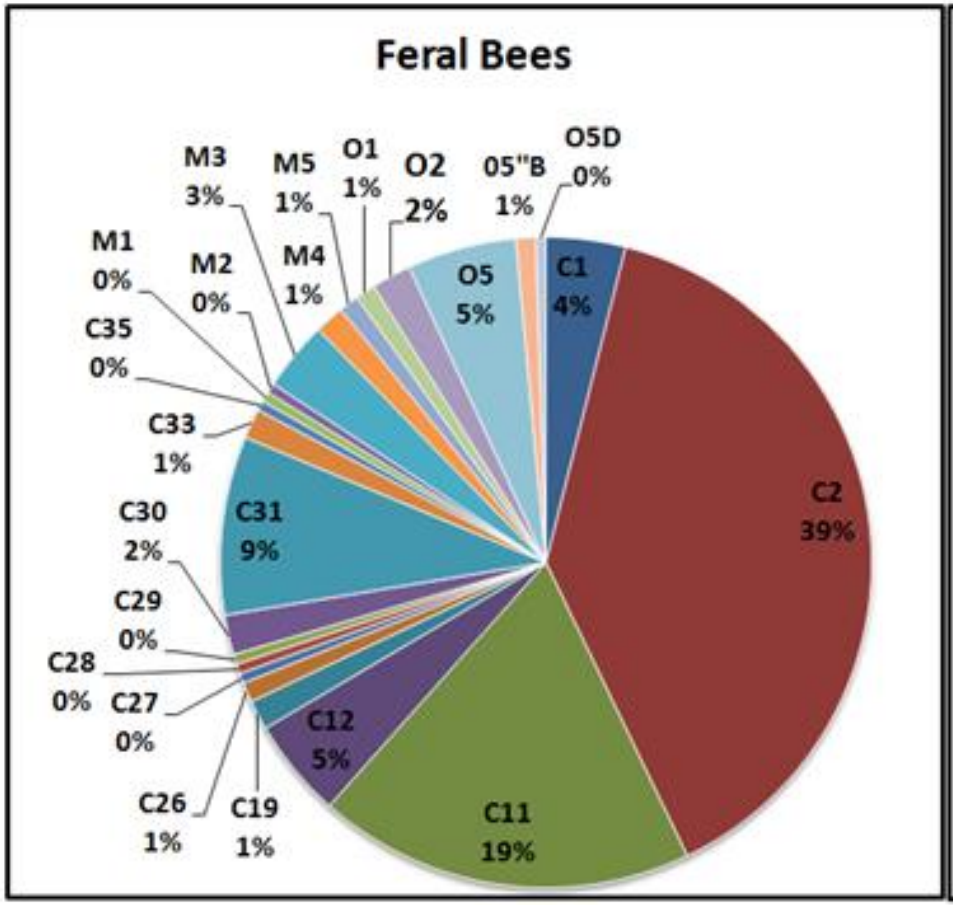
POL line

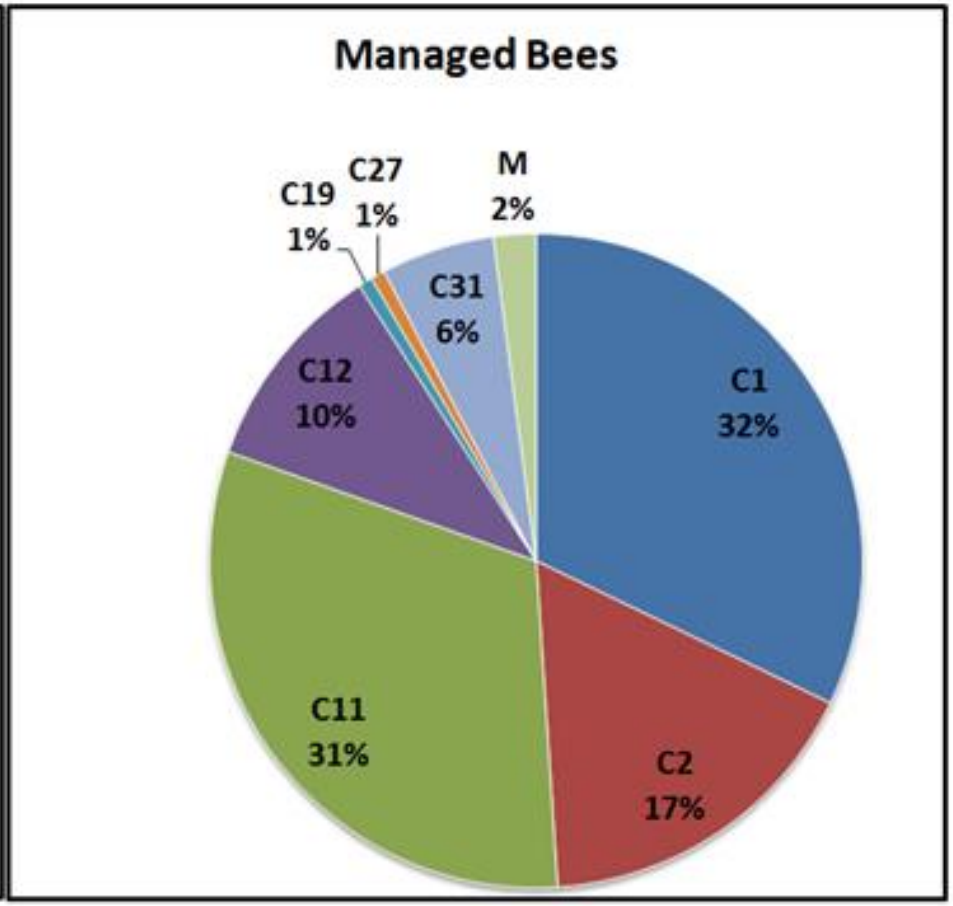
Russian bees

USDA varroa-resistant bee bloodlines

VSH







Mitotype analysis of U.S. bee populations.

Domesticated bees are bred for traits other than survivorship. Better luck with ferals.

How to be part of the solution:

Start each spring with a number of queens grafted from resistant colonies.

Then start the "varroa race."


Monitor the mite buildup rate for each hive.

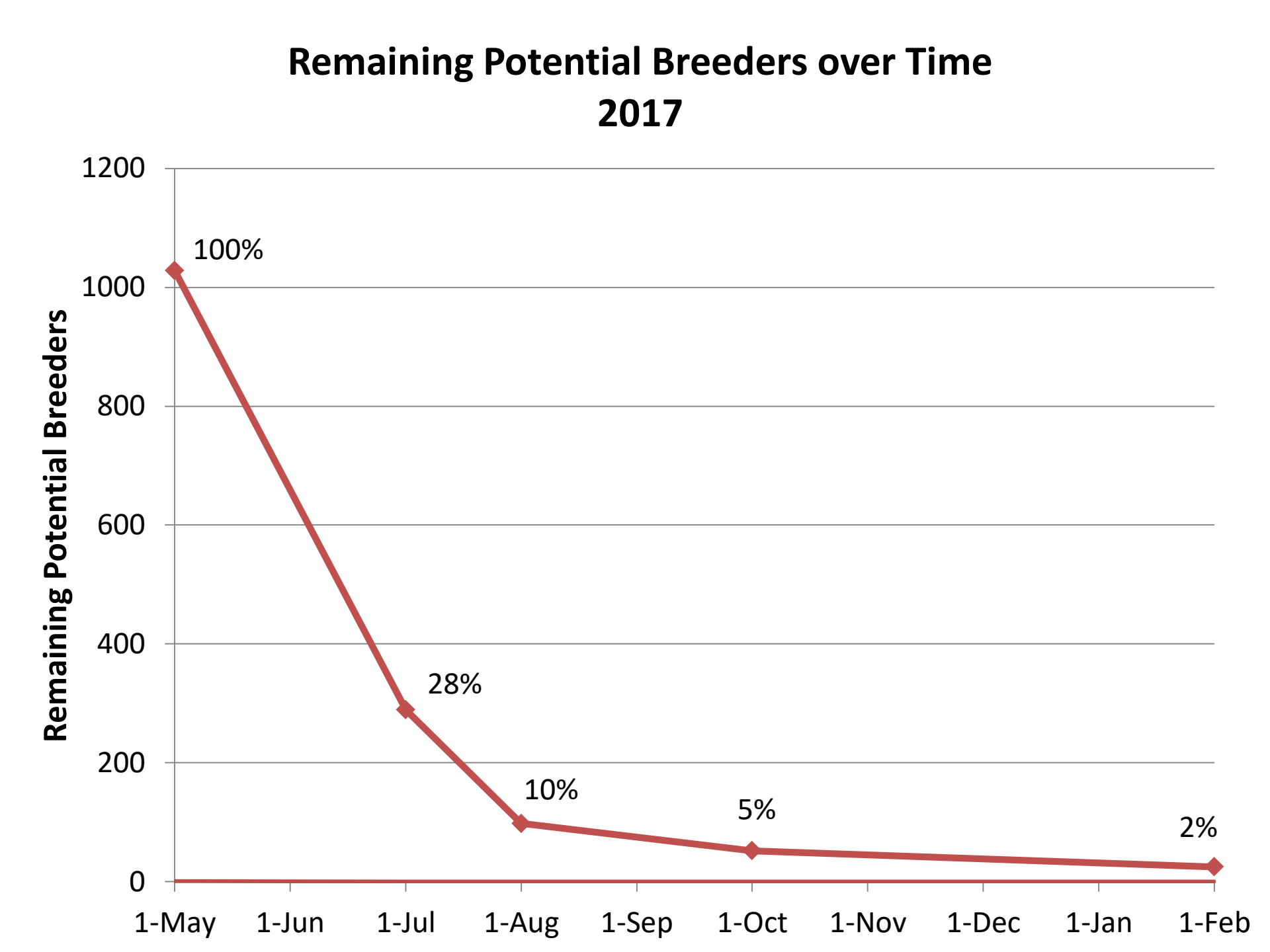
Remove high-mite hives from the breeding program, treat them, and requeen them. There's no need for the colony to die!

There is no need to burn the ship, just to get rid of the cockroaches.

(paraphrasing Thomas Huxley 1873)

Selection takes place at the queen level.

There is no need to punish the colony for the queen's genetics!

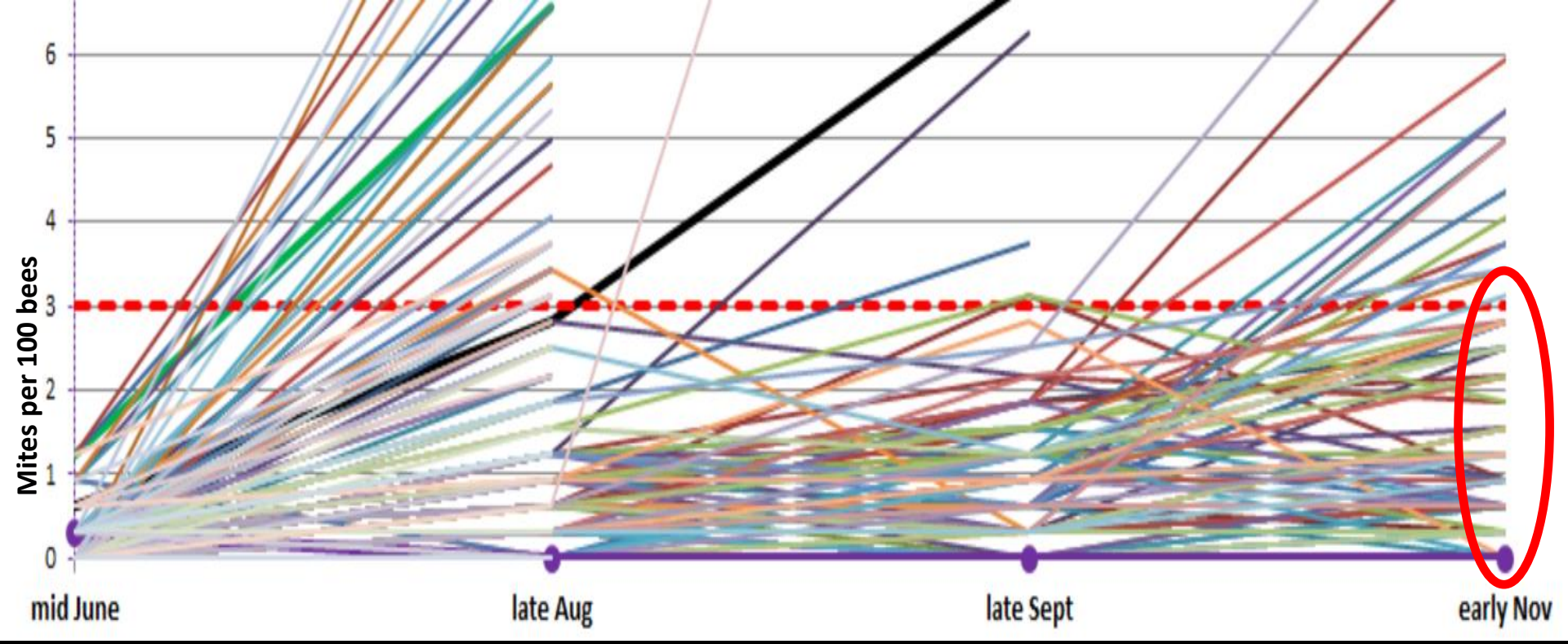

Remaining Potential Breeders over Time
2017
Remaining Potential Breeders
1200
1000
800
600
400
200
0
100%
28%
10%
5%
2%
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb

The Problem: the pain of monitoring

Smokin’ hot mite washin’

Show video

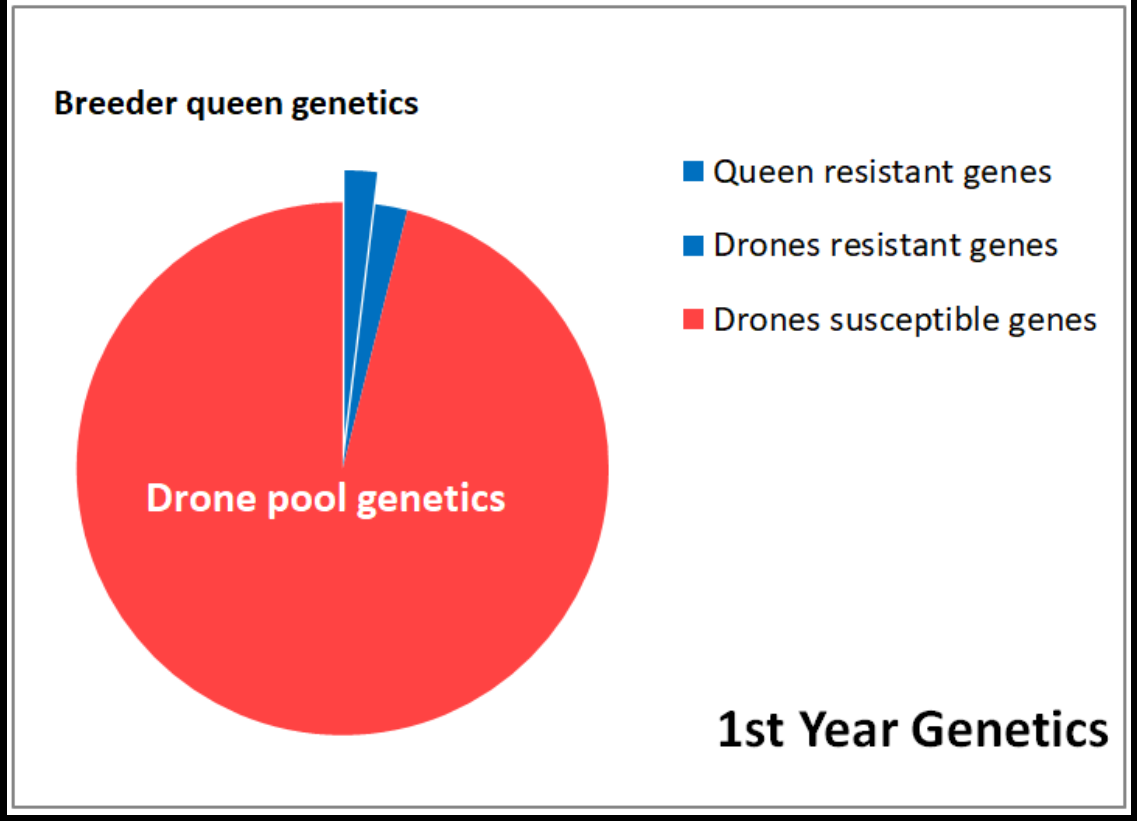
Randy mite wash with shaker



2018 Results similar

- As of November, 5% of hives have kept mite counts at or below 3% infestation.
- Several pulled mite counts down.
- 5 colonies scored zero mites in early November.
- One productive hive kept mites at zero all late season.

Each season's queens supply half the genes for the next generation.



Last season 2% of my starting breeding population exhibited strong resistance to varroa.; *98% did not.*

I restocked my operation this season with daughters from those queens. But they mated with 98% mite-susceptible drones.

Next season, half the drones may carry resistance alleles.

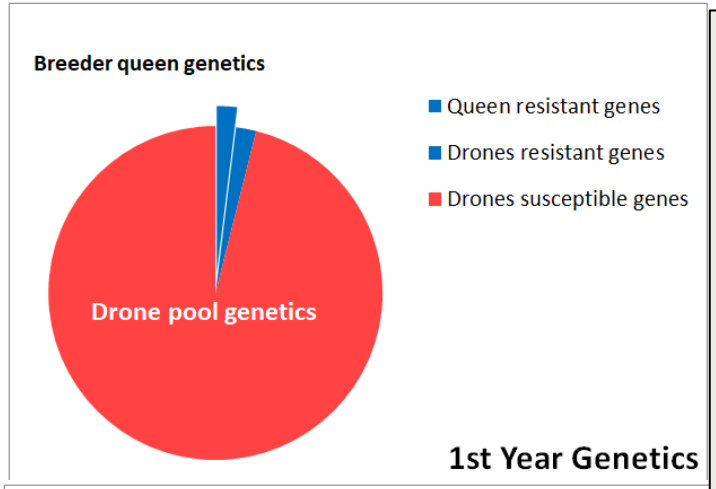
A SLOW PROCESS OF ELIMINATION

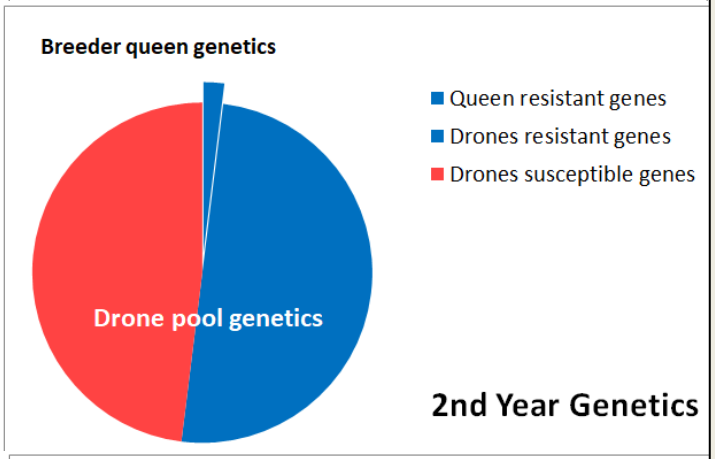
Blue represents genes for resistance, red represents genes for mite susceptibility.

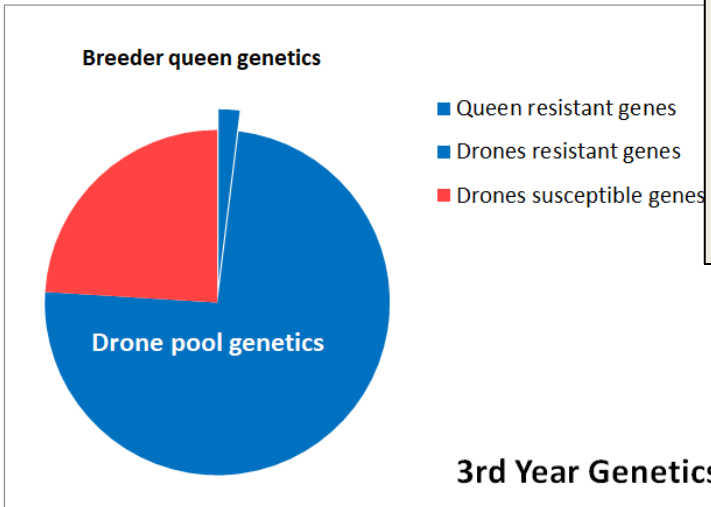
Even if you requeen *every* hive each year with a resistant daughter queen,

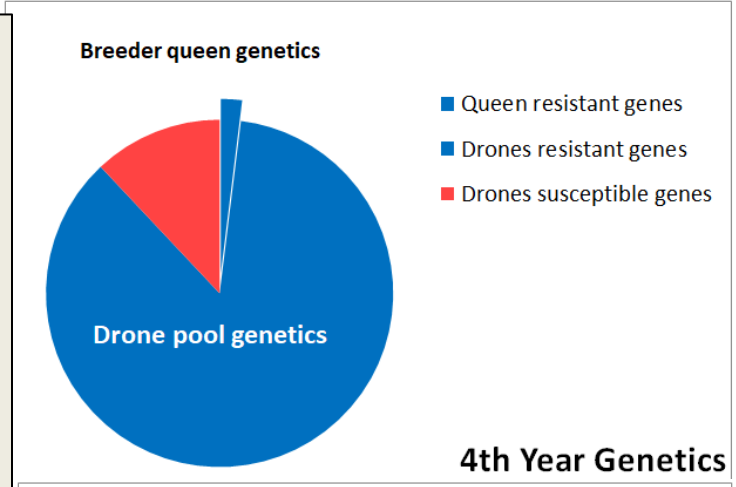
***and* completely control matings,**

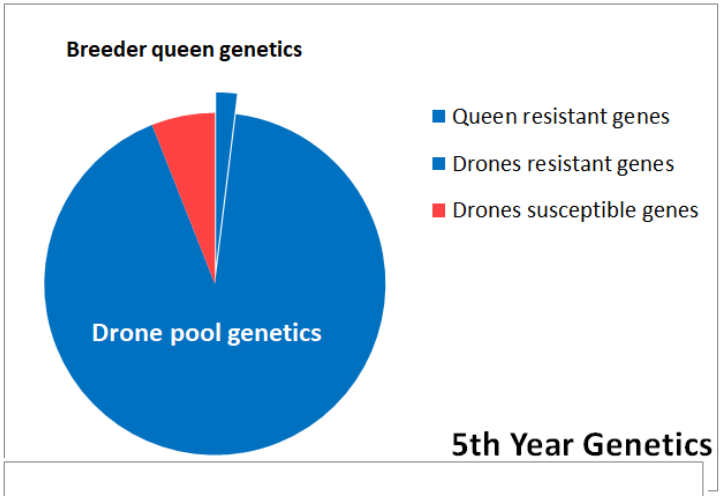
you can only reduce the genes for mite susceptibility by *half* each year.

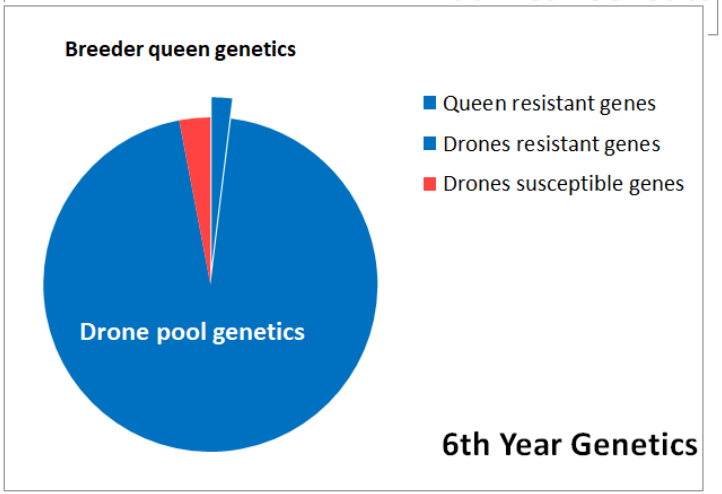












Remember, you're not helping the Big Picture unless you spread the genetics.

REALITY CHECK

Unless you can control the matings of a large number of colonies, you have little chance of success at shifting the genetics of a breeding population.

☹

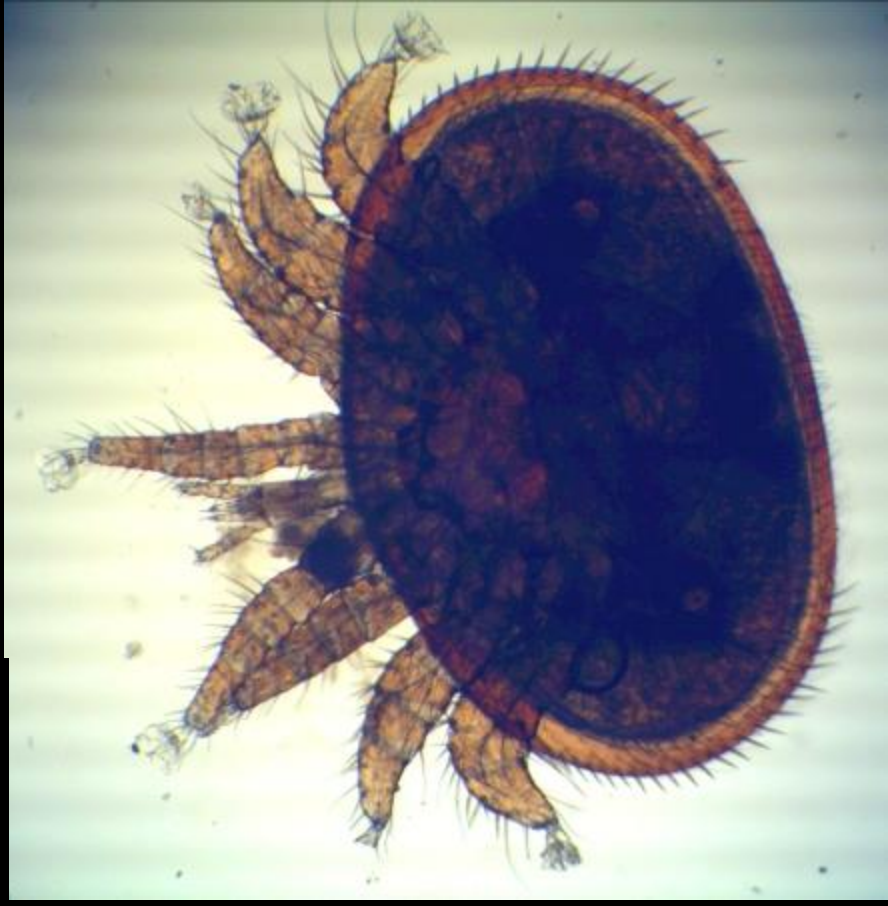

PROBLEM
THERE'S NO GOOD
MIDSUMMER TREATMENT
WHEN HONEY IS ON


A Solution:
An organic midsummer
varroa treatment


Oxalic acid:
Safe and natural

Absorption through mite tarsal pads.

Photos courtesy Bernhard Heuvel



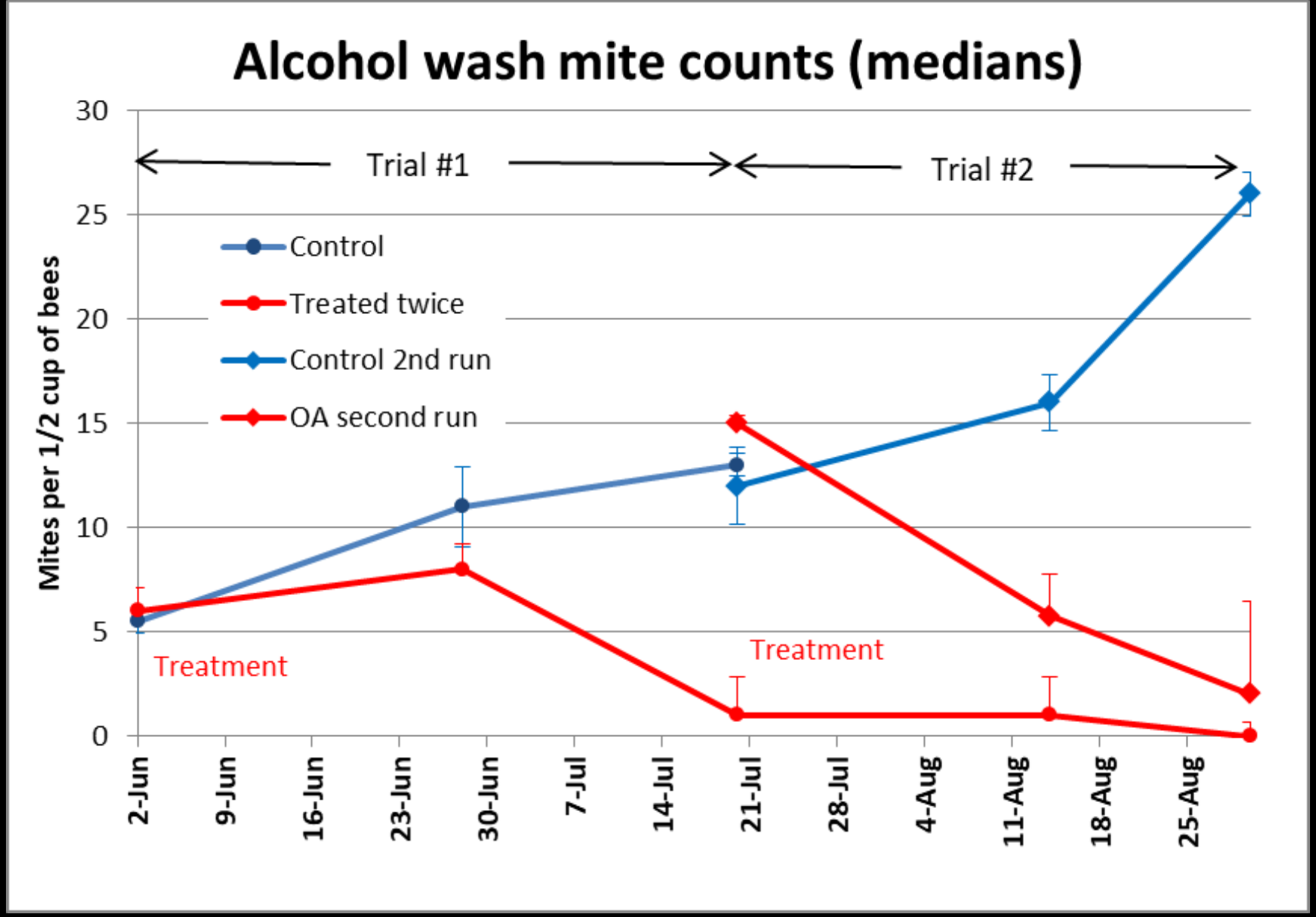
Also possible effect upon mite olfaction.


Oxalic dribble

Extended-release OA in glycerin from Argentina?


Another application method?

Thanks to helpful EPA,
Jay Evans, USDA-ARS
Jennifer Berry, Univ. Georgia
Geoff Williams, Auburn Univ.



Promising results in 2017 summer trials.

Questions to answer:

- Rapidity of action, duration of effect?
- Minimum required dose of OA per treatment?
- How is the OA distributed from the towel to the mites?
- Optimal ratio of OA to glycerin for best distribution?
- Optimal degree of glycerin saturation of the towel for best exposure?
- Would propylene glycol be a better carrier?

Prepare towels for field testing


Large-scale field trial
200+ hives
First take alcohol washes


Track mite
infestation level
over time

Lay out treatments to apply


Double check
before application

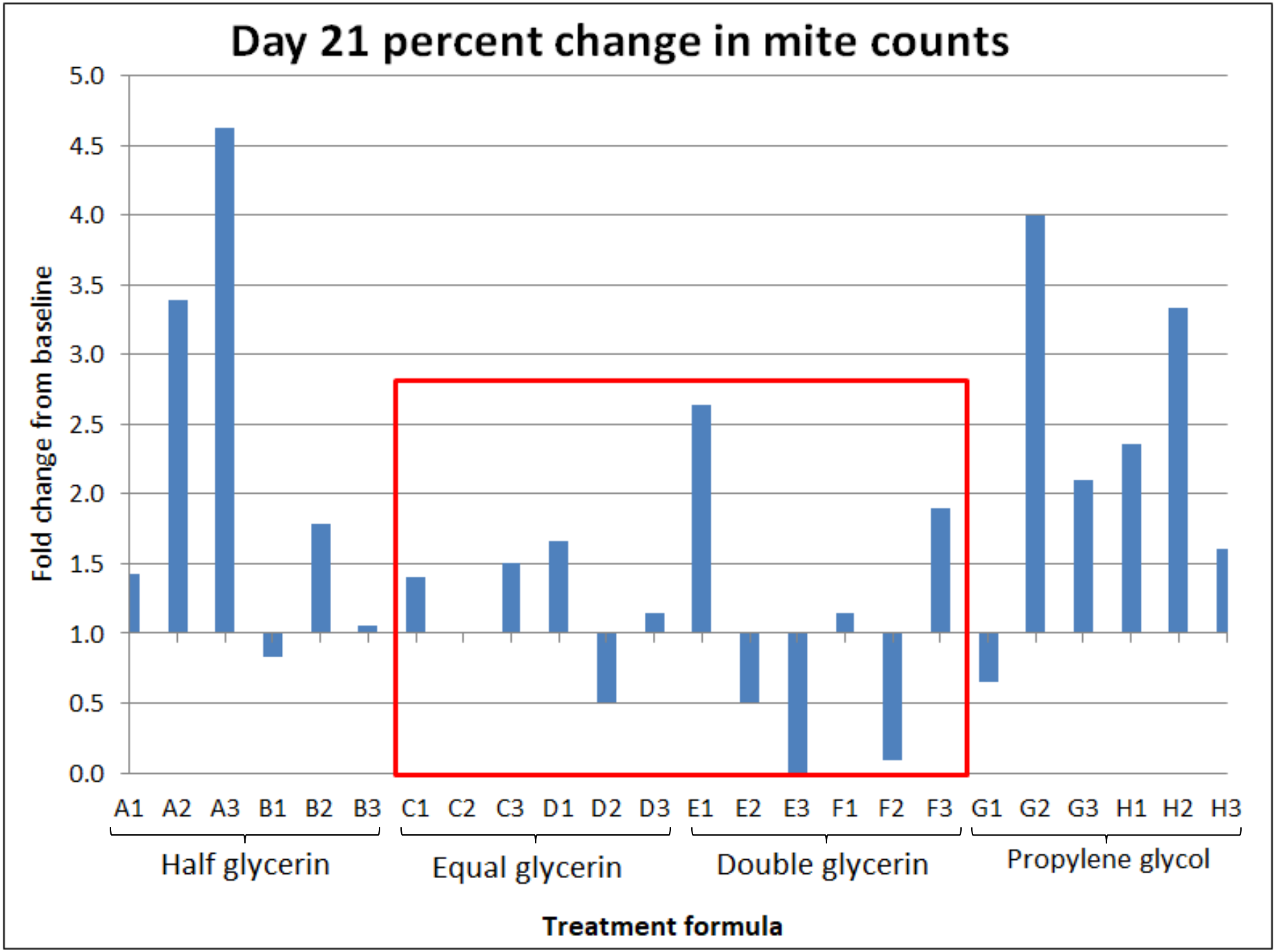

Apply towels


14 yards,
225 hives in trial

Field assessment of ease of formula application

Table 2. Field notes for towel consistency at application (after sitting for a few weeks after preparation).	
A: Half gly, wet	Very easy to apply—OA mostly crystallized and rigid.
B: Half gly, dry	Easy to apply.
C: Equal gly, wet	Sloppy and difficult.
D: Equal gly, dry	Fairly easy to apply.
E: Double gly, wet	Towels very sloppy and transparent, messy.
F: Double gly, dry	Sloppy and difficult.
G: Equal PG, wet	**Towels degraded**, difficult to apply. Hot in sun*
H: Equal PG, dry	Fairly easy to apply.
M: 4x gly, half dose OA	Sloppy.
*I can't explain it, but this formulation appeared to undergo a chemical reaction when placed upon a hive cover in the sun, and became noticeably hot to the touch.	

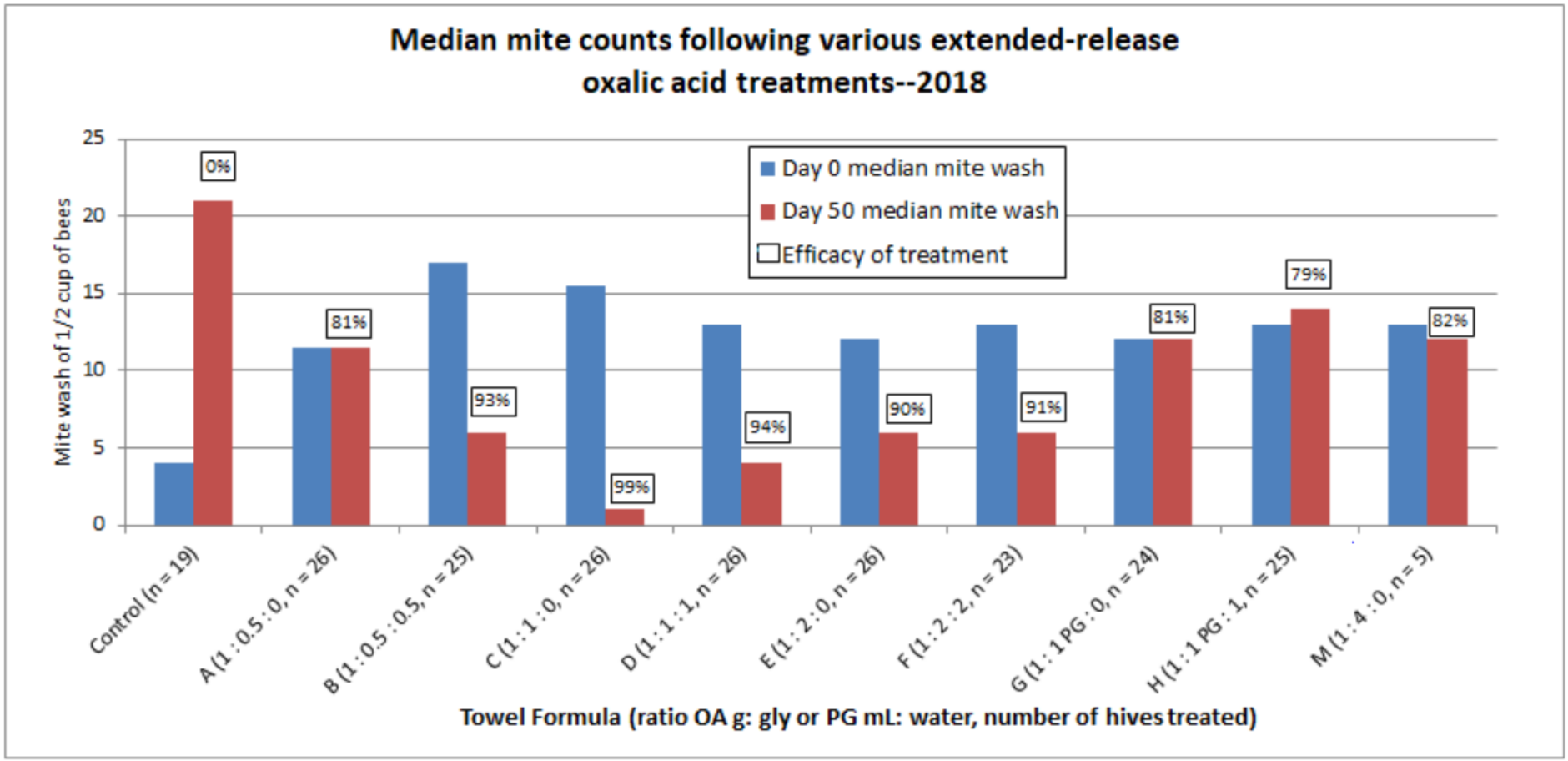
Agitation, and avoidance of one formulation


Day 21 percent change in mite counts
Fold change from baseline
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
A1 A2 A3 B1 B2 B3 C1 C2 C3 D1 D2 D3 E1 E2 E3 F1 F2 F3 G1 G2 G3 H1 H2 H3
Half glycerin
Equal glycerin
Double glycerin
Propylene glycol
Treatment formula

Neutralize acid contamination


Check for OA residues in the honey


Wait 50 days to take
follow-up mite washes.



2018 trial efficacies up to 99% in California!

Note: efficacy perhaps not as good in trials run in Georgia.

Pros:

Easy on the bees.

Inexpensive.

One-time application.

Cons:

Slow action over 6 weeks.

Residues to scrape out.

Apply when you put honey supers on.
Few mites when you pull honey!
Not yet registered, but sure looks promising!

For New Zealand beekeepers only:

Current formula and mixing directions at ScientificBeekeeping.com

Articles By Publication Date

My articles constitute a journal of my own learning experience in the science of beekeeping, and should be consi
context. I make an effort to add important updates to articles on this site, but it may help the reader to see the
publication, so that one can read the most up to date articles first.

Edit

Article Title	Publication Date
2018	
Extended-Release Oxalic Acid Progress Report — 2018 California Field Trial	November

ScientificBeekeeping.com

Beekeeping Through a Biologist's Eyes

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What This Site Is About

ZOMBIE BEE UPDATE

The parasitic phorid fly was reported about a year ago–I presented about it at the national conventions. It appeared to be more of a novelty than a concern, and no one paid much attention. The the authors finally published a formal paper, and the press extrapolated it wildly into being the cause of CCD. Now, all of us are being deluged by people wanting to know about the fly.

The fly is a native parasite that normally parasitizes bumblebees and paper wasps. The authors write:

"It is possible that A. borealis expanded its host range to include the non-native honey bee many years ago and has gone unnoticed because infected bees abandon their hive and flies occurred undetected in low densities. We believe it is more likely that the phenomenon we report represents a recent host shift and an emerging problem for honey bees."

If this is indeed a host shift, that would be bad news. But it could simply be that we've just never noticed it. I've spoken with the large commercial beekeeper in whose operation the fly was discovered, and he hasn't even noticed it.

In the Bay Area hives that the researchers studied, it only

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Many beekeepers have requested reprints of my articles from the American Bee Journal (hit the Dadant ad above). Since I wish to update each article regularly, I feel that online access would allow them to remain current, and allow me to incorporate feedback from readers. Please feel free to donate to help with the costs of maintaining this site. My guess is that the accurate information, new ideas, and practical advice on these pages will return any investment many times over in the form of healthier colonies and increased production.

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I am continually doing practical beekeeping research, including incubator and field trials for bee health issues, tests of new products, protein supplements, and varroa, nosema, and virus treatments.

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