Oxalic Acid in Varroa Management

Randy Oliver

Revised 14 Jan 2016

(see notes under the slides)

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Review article

Oxalic acid for the control of varroosis in honey bee colonies – a review[1]

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Received 17 February 2005 – revised 17 June 2005 – accepted 26 July 2005

Abstract – The review summarizes research results on the use of oxalic acid as an acaricide in honey bee colonies. Three different treatment techniques (i.e. trickling, evaporation and spraying) have been developed for the application of oxalic acid. Detailed information is given on the efficacy against *Varroa destructor*, tolerability by *Apis mellifera*, protective procedures for the user, residue situation and consumer safety, as well as recommendations for use.

Oxalic has a long history in Europe

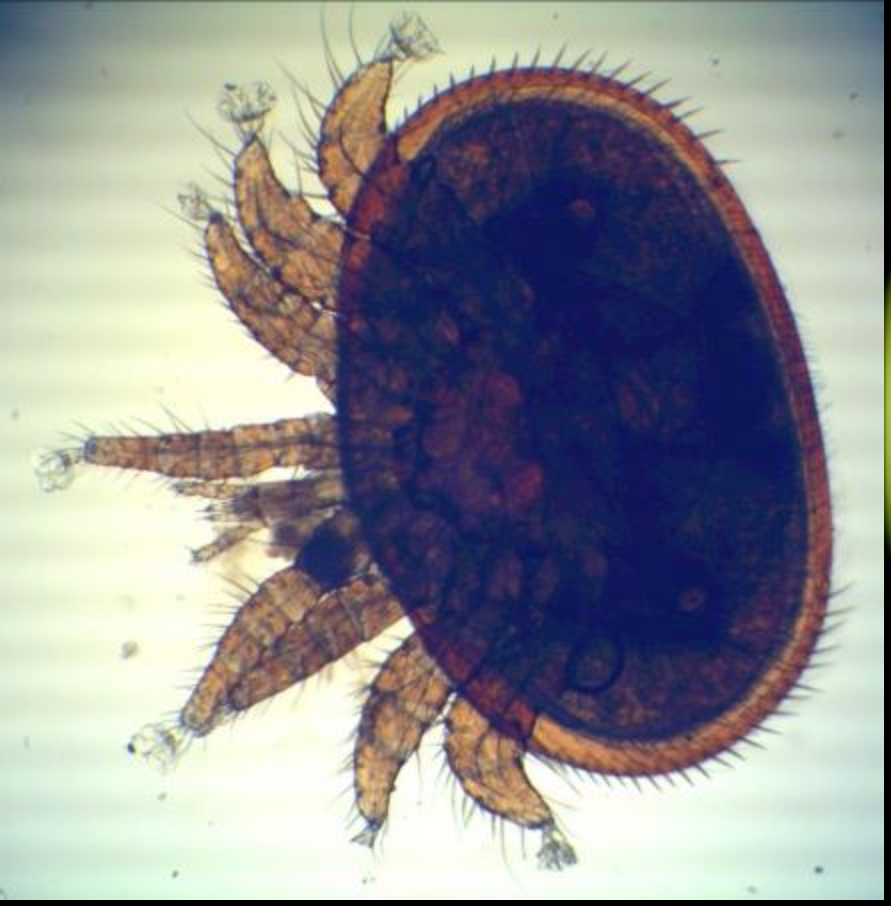
Why Oxalic Acid?

Acids are much more toxic to mites than to bees

Oxalic is the strongest organic acid

pH of Organic Acids – Sorted by increasing pH

Formula	Name	Alternative name	1 mM	10 mM	100 mM
$C_2H_2O_4$	oxalic acid	ethanedioic acid	3.00	2.09	1.31
$C_4H_4O_4$	maleic acid	toxilic acid	3.05	2.21	1.54
$C_4H_6O_8$	dihydroxytartaric acid		3.04	2.20	1.54
$C_6H_6O_6$	cis-aconitic acid		3.05	2.21	1.55
$C_4H_4O_5$	oxaloacetic acid	oxalacetic acid	3.05	2.29	1.68
$C_5H_6O_5$	oxoglutaric acid	ketoglutaric acid	3.09	2.36	1.77
$C_3H_4O_3$	pyruvic acid	acetylformic acid	3.11	2.38	1.79
$C_4H_6O_3$	2-oxobutanoic acid	alpha-ketobutyric acid	3.11	2.38	1.79
$C_6H_6O_6$	trans-aconitic acid		3.14	2.48	1.92
$C_3H_4O_4$	malonic acid	propanedioic acid	3.17	2.50	1.94
$C_8H_6O_4$	phthalic acid	ortho-phthalic acid	3.20	2.55	2.00
$C_4H_6O_6$	L-tartaric acid	racemic acid	3.18	2.55	2.01
$C_7H_6O_4$	gentisic acid	"2,5-dihydroxybenzoic"	3.21	2.56	2.01
$C_7H_6O_3$	salicylic acid	2-hydroxybenzoic acid	3.21	2.57	2.02
$C_4H_4O_4$	fumaric acid	allomaleic acid	3.19	2.57	2.03
$C_4H_6O_6$	DL-tartaric acid	racemic acid	3.19	2.58	2.03
$C_4H_6O_4$	methylmalonic acid		3.23	2.60	2.05
$C_5H_6O_4$	mesaconic acid	dimethylfumaric acid	3.23	2.61	2.06
$C_4H_6O_6$	meso-tartaric acid	racemic acid	3.24	2.62	2.08
$C_6H_8O_7$	citric acid		3.24	2.62	2.08
$C_2H_2O_3$	glyoxilic acid	oxoacetic acid	3.27	2.65	2.11
$C_6H_8O_7$	isocitric acid		3.28	2.69	2.16
$C_4H_6O_5$	malic acid		3.33	2.74	2.21
$C_8H_8O_3$	mandelic acid	phenylglycolic acid	3.34	2.75	2.22
$C_8H_6O_4$	isophthalic acid	meta-phthalic acid	3.33	2.76	2.24
$C_8H_6O_4$	terephthalic acid	para-phthalic acid	3.36	2.79	2.26
$C_3H_6O_4$	glyceric acid		3.38	2.80	2.27
$C_4H_6O_3$	acetoacetic acid	diacetic acid	3.40	2.83	2.30
$C_4H_8O_3$	hydroxybutanoic acid		3.43	2.86	2.33
CH_2O_2	formic acid	methanoic acid	3.47	2.91	2.38
$C_2H_4O_3$	glocolic acid	hydroxyacetic acid	3.50	2.94	2.42
$C_5H_6O_4$	itaconic acid	methylenesuccinic acid	3.50	2.95	2.43
$C_3H_6O_3$	lactic acid	milk acid	3.51	2.96	2.44
$C_8H_8O_2$	toluic acid	ortho-toluic acid	3.53	2.98	2.46
$C_6H_8O_6$	ascorbic acid	vitamin C	3.59	3.04	2.53
$C_5H_8O_4$	methylsuccinic acid		3.62	3.08	2.57
$C_7H_6O_2$	benzoic acid		3.66	3.12	2.60



http://www.varroamilbe.ch

There are speculative hypotheses as to why acids kill varroa, but no definitive study.

Beekeeper Gerhard Bruning suspects that OA crystals are absorbed through varroa's sticky tarsal pads.

Safety to Humans


Oxalis

Table I: Oxalic acid content in selected vegetables. These are ballpark numbers, actual content depends on many variables. See note ate the end of the article.

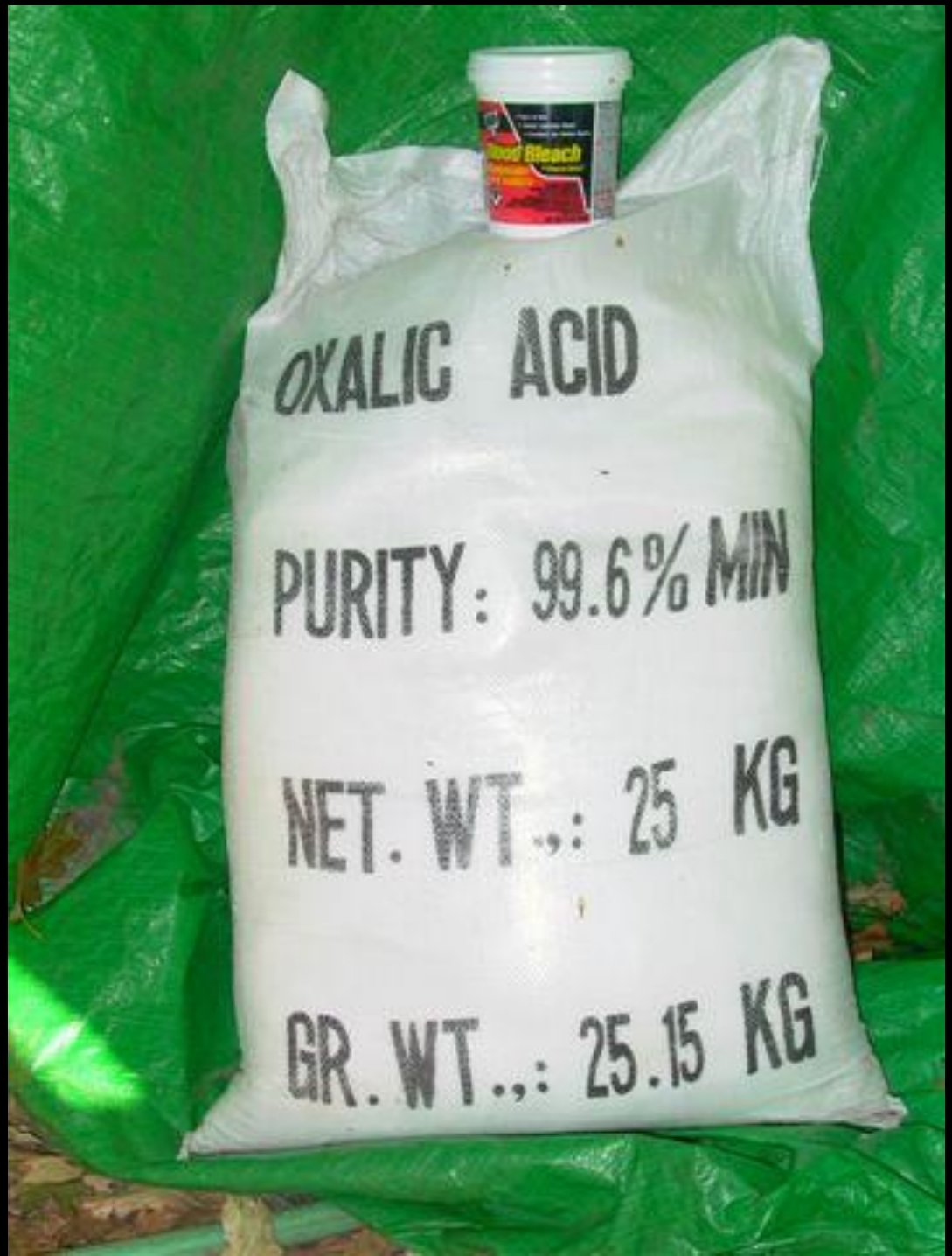
Vegetable	Oxalic acid (g/100 g)
Asparagus	0.13
Broccoli	0.19
Lettuce	0.33
Brussels sprouts	0.36
Collards	0.45
Beet leaves	0.61
Spinach	0.97 (0.32-1.26)
Purslane	1.31
Parsley	1.70
Rhubarb	0,3-1.5
leaf	0.59 - 0.72
stalk	0.39 - 0.54

Typical treatment=

1 serving

per hive

Purchasing Oxalic Acid



Sold as

oxalic acid dihydrate

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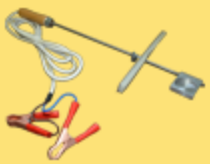
Free Shipping *does not* apply to **international orders**, **back ordered items shipped separately**, **glass jars**, **honey** or **syrup**, LTL shipments will be sent out at no charge but any accessorial fees will be billed to customer's account.
Other restrictions may apply.

Search Results for : "oxalic"

Item #	Image	Description
727		Oxalic Acid Shp. Wt. 1 lb.
727K		Kit for Oxalic Acid Ship wt. 2 lbs. In Stock
727OAV		Varrocleaner Ship wt. 3 lbs. In Stock

This is the only registered and legal oxalic product!

Mixing Oxalic Syrup

Need to weigh

Don’t use hard water

ScientificBeekeeping.com

Beekeeping Through the Eyes of a Biologist

Search Go! Home Contact Me

Oxalic Acid Treatment Table

Save PDF Email Print

Be sure to read "Oxalic Acid – Questions and Answers" and "The Learning Curve – Part 3" before using oxalic acid. It is critical to apply it correctly, or you risk seriously harming your bees!"

Important Note: the following proportions refer to common oxalic acid dihydrate (wood bleach). If you manage to get your hands on pure laboratory oxalic acid, you must reduce the amount of acid to only 7/10ths of that of the dihydrate !!!!

Also note that if you use hard water, some of the oxalic acid will precipitate out as calcium oxalate, and thus reduce the efficacy (you'll easily see the white precipitate if this is the case.

Oxalic strength →	"Hot" 4.2% w:v	"Medium" 3.2% w:v	"Weak" 2.5% w:v	Notes
OA Crystals	1	0.75	0.6	Oxalic crystals must be measured by weight. Sugar and water are about the same by weight or volume (1 pint of either granulated sugar or water weight 1 lb)
Sucrose	10	10	10	
Dist. Water	10	10	10	
OA Crystals	60g	45g	35g	Makes 1 liter:

Please Share

Use the exact dose!

Oxalic strength→	***"Hot" 4.2% w:v***	***"Medium" 3.2% w:v***	***"Weak" 2.5% w:v***	Notes
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Sucrose	**10**	**10**	**10**	
Dist. Water	**10**	**10**	**10**	
OA crystals	**60g**	**45g**	**35g**	
Sucrose	**600g**	**600g**	**600g**	Makes 1 liter Treats about 20 colonies
Dist. water	**600ml**	**600ml**	**600ml**	
OA crystals	**100g**	**75g**	**60g**	
Sucrose	**1 kg**	**1 kg**	**1 kg**	Makes 1700ml Treats about 33 colonies
Dist. water	**1 liter**	**1 liter**	**1 liter**	
OA crystals	**232g**	**174g**	**139g**	
Sucrose	**5 lb**	**5 lb**	**5 lb**	Makes 1+ gallon Treats about 75 colonies
Dist. water	**2.5 qt**	**2.5 qt**	**2.5 qt**	
OA crystals	**1112g (2lb 7oz)**	**834g (1lb 13.4oz)**	**667g (1lb 7.5oz)**	
Sucrose	**25 lb**	**25 lb**	**25 lb**	Makes 5 gallons Treats about 375 colonies
Dist. water	**3 gal**	**3 gal**	**3 gal**	

Oxalic acid crystals dissolve more readily in hot water than in sugar solution.

Tip: dissolve the oxalic crystals in the indicated amount of hot (150˚F) water before adding the sugar.

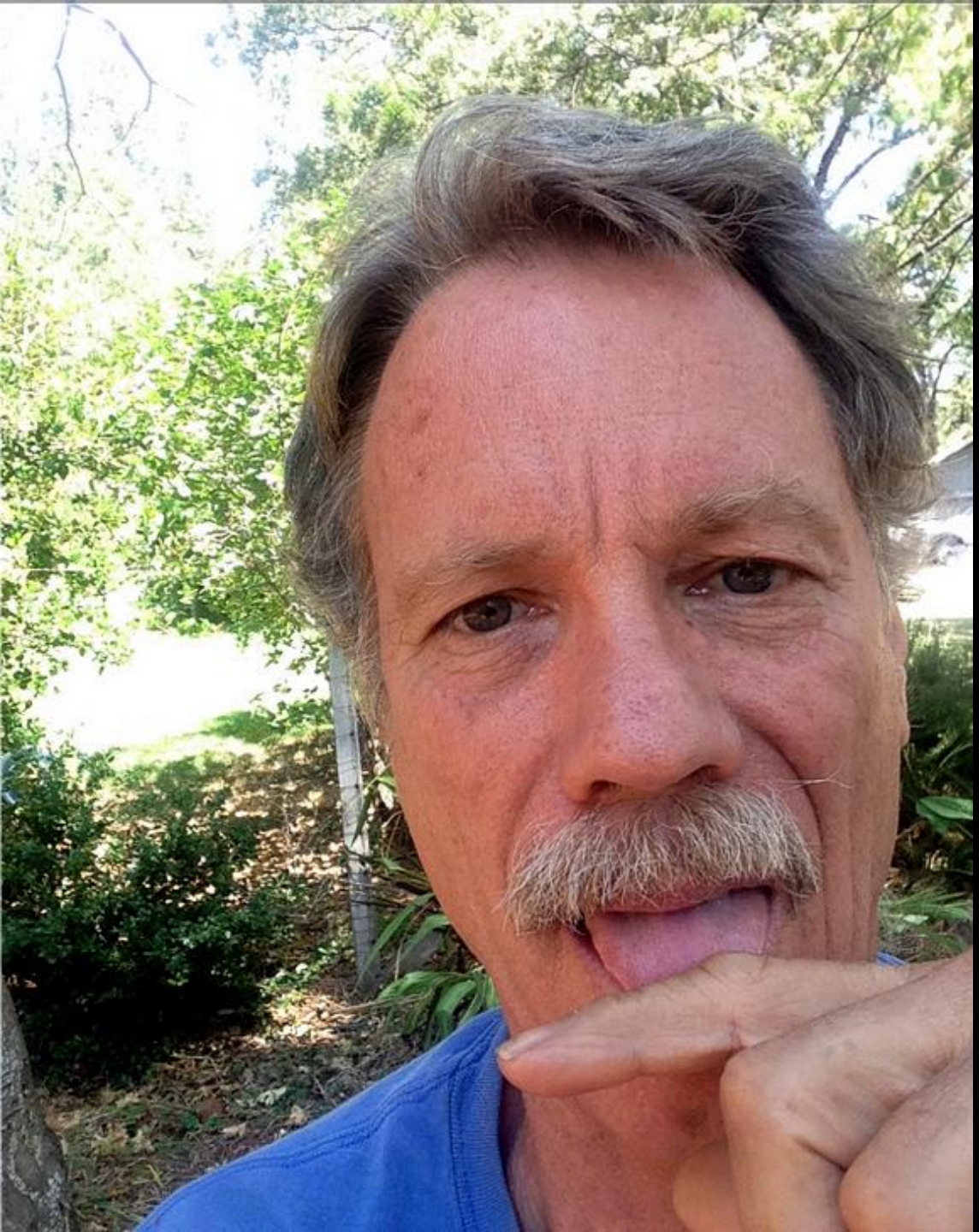
After the oxalic crystals are *fully dissolved*, *only then* stir in the sugar.

Storage

Store in the ‘fridge

Safety

Protect your eyes



Tastes like strong lemonade

Carry baking soda in water to neutralize

Application


Must be applied directly
to bees' bodies.


~5 mL per "seam" of bees

1 tsp = 5 mL


Dribble, not spray

Calibrate pump output

Hit both boxes

Tips:

Fill the garden sprayer only about ¼ full of solution. This leaves a large air space, which minimizes the fluctuation in pressure.

After you've dribbled a yard of hives, measure how much syrup you've applied in total, and divide by the number of hives. This will tell you if you're applying the correct amount.

Timing of Treatment

Oxalic won’t kill mites in the brood.

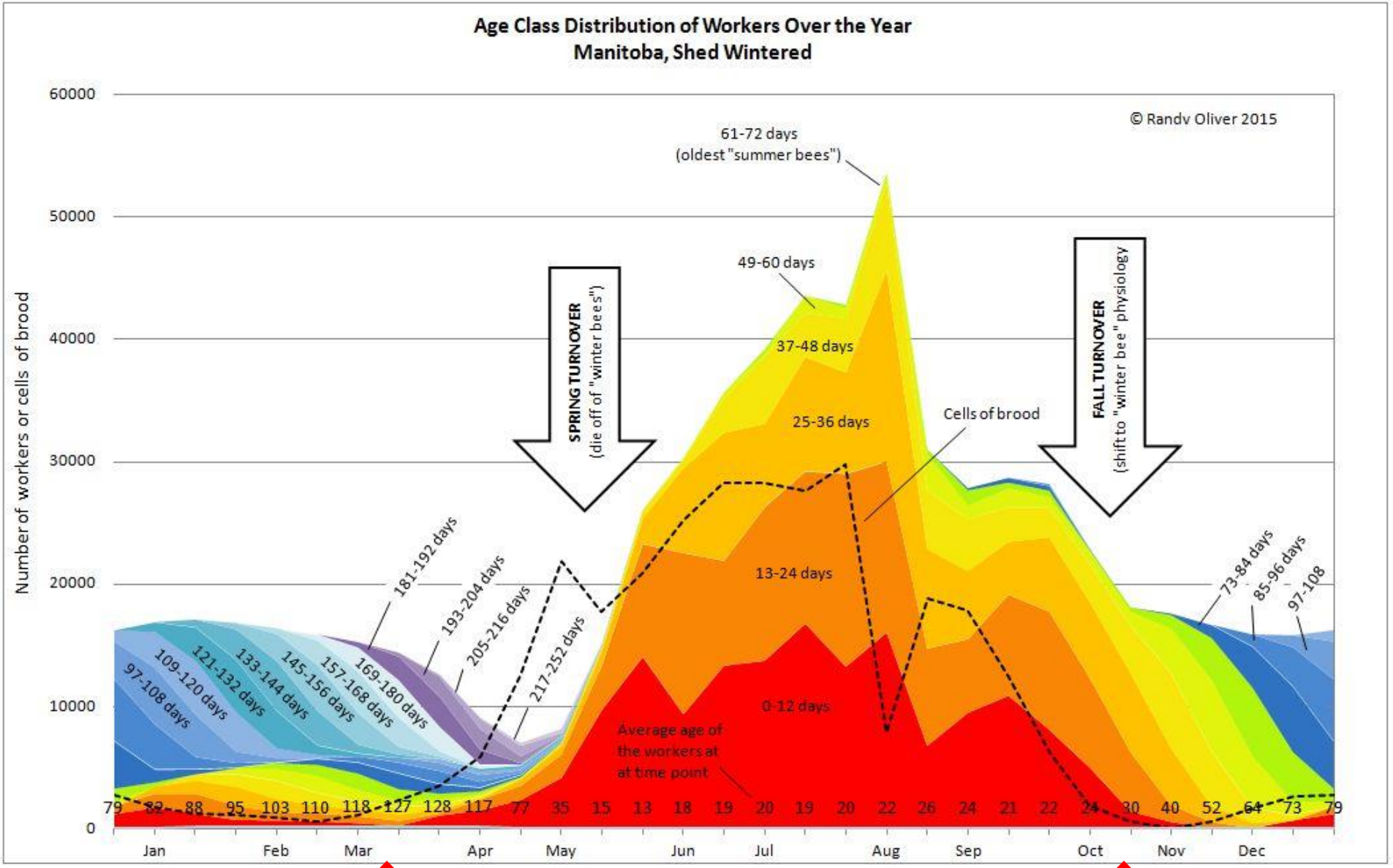
Kill rate of phoretic mites

90 ← you can change this value

Percent of full broodnest	Estimated percentage of mites in the brood	Estimated percentage of mites phoretic	Kill rate of phoretic mites	**Percent kill of total mite population**
100	70%	30%	90%	**27%**
90	63%	37%	90%	**33%**
80	56%	44%	90%	**40%**
70	49%	51%	90%	**46%**
60	42%	58%	90%	**52%**
50	35%	65%	90%	**59%**
40	28%	72%	90%	**65%**
30	21%	79%	90%	**71%**
20	14%	86%	90%	**77%**
10	7%	93%	90%	**84%**
0	0%	100%	90%	**90%**

Note the difference in efficacy, dependent upon how much brood is present.

Oxalic gives poor efficacy if there is much brood present, especially if drone brood is present.



Best treatment windows

Oxalic acid is, by far, most effective when colonies are broodless.

We use our fall oxalic dribble as a last check on our colonies before winter.

Oxalic drops mites
for about 4 days.

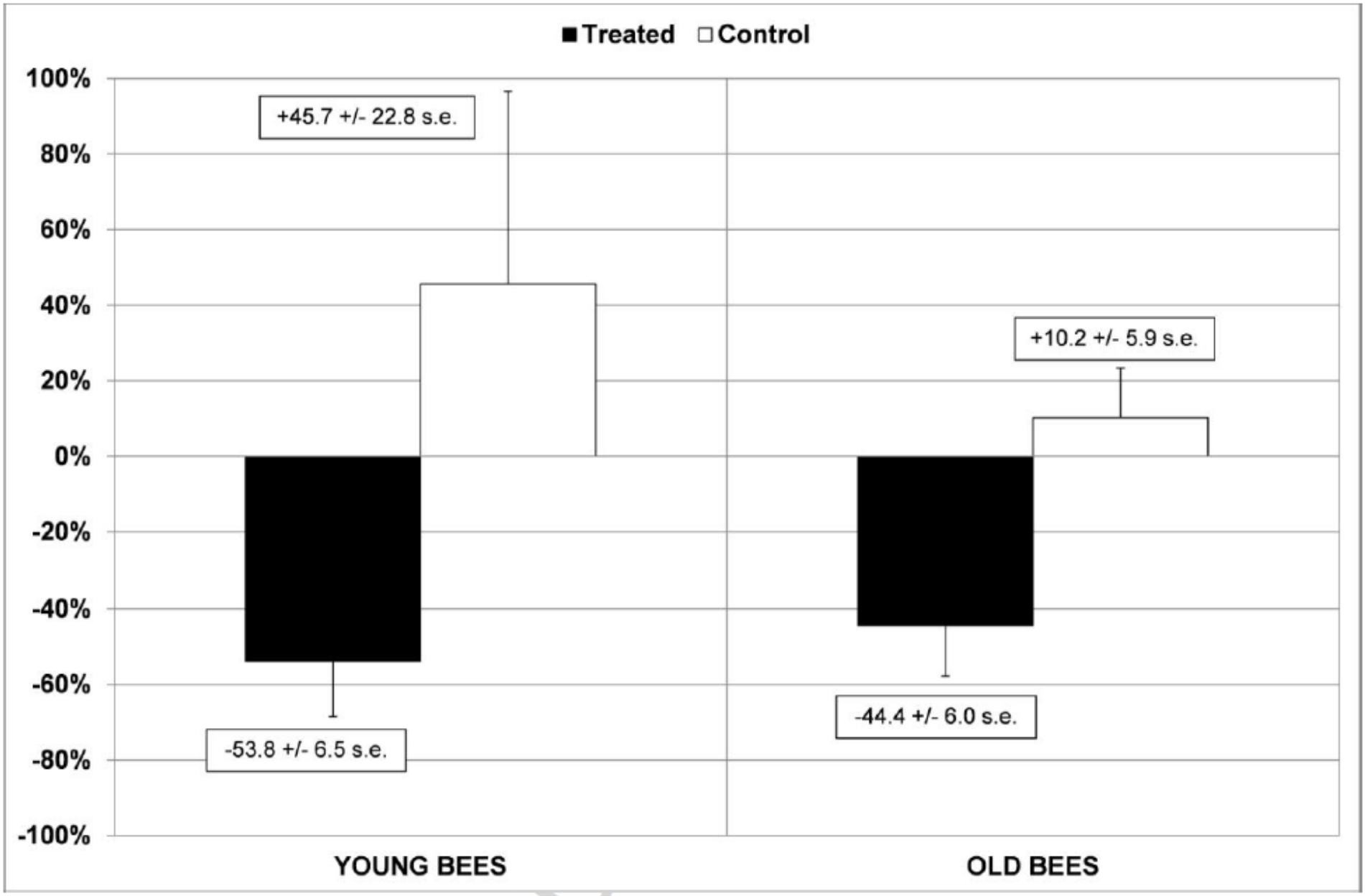
Benefit against nosema

Accepted Manuscript

Effect of oxalic acid on *Nosema ceranae* infection

Antonio Nanetti, Cristina Rodriguez-García, Aránzazu Meana, Raquel Martín-Hernández, Mariano Higes

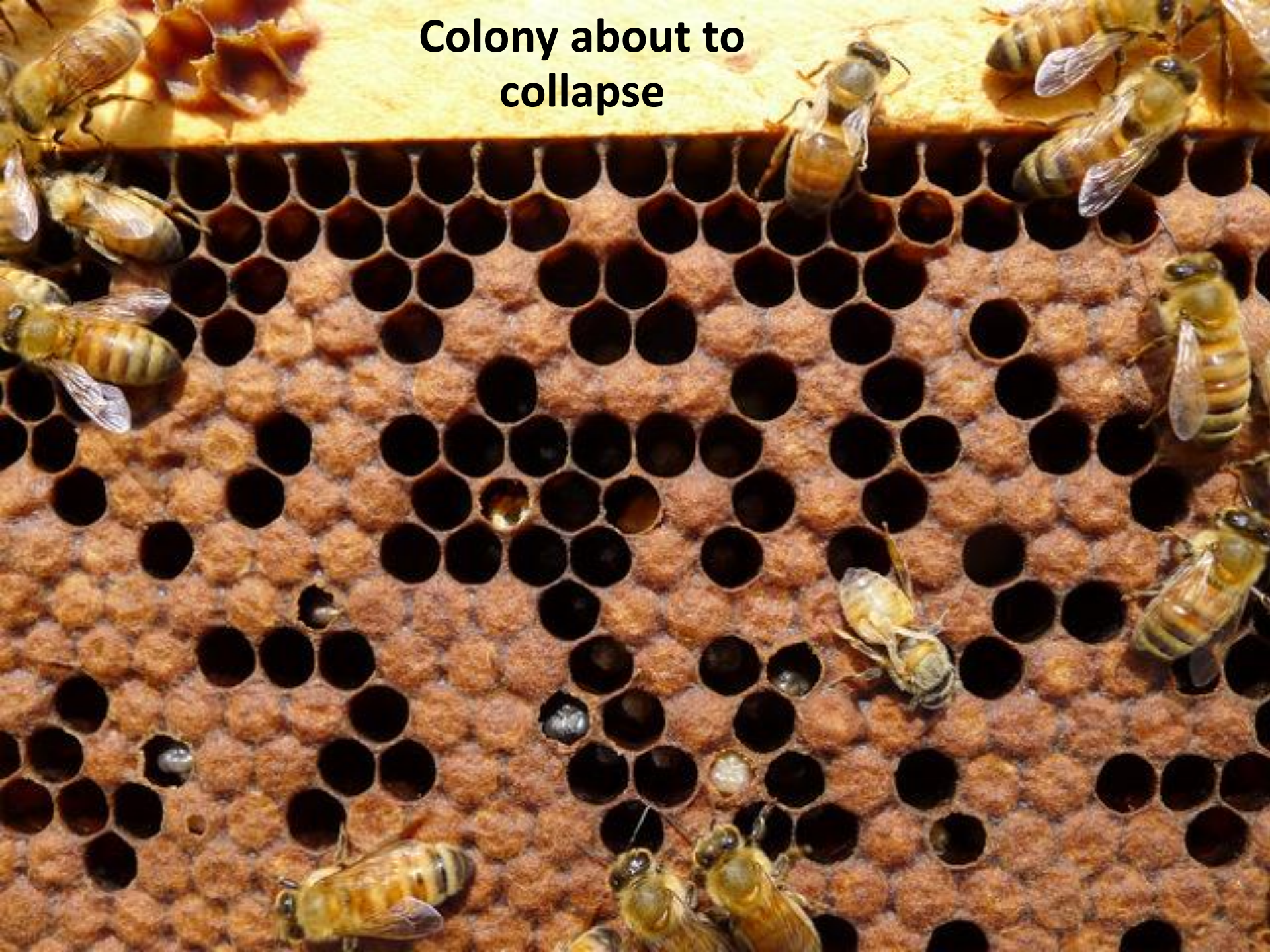
PII: S0034-5288(15)30033-3
DOI: doi: 10.1016/j.rvsc.2015.08.003

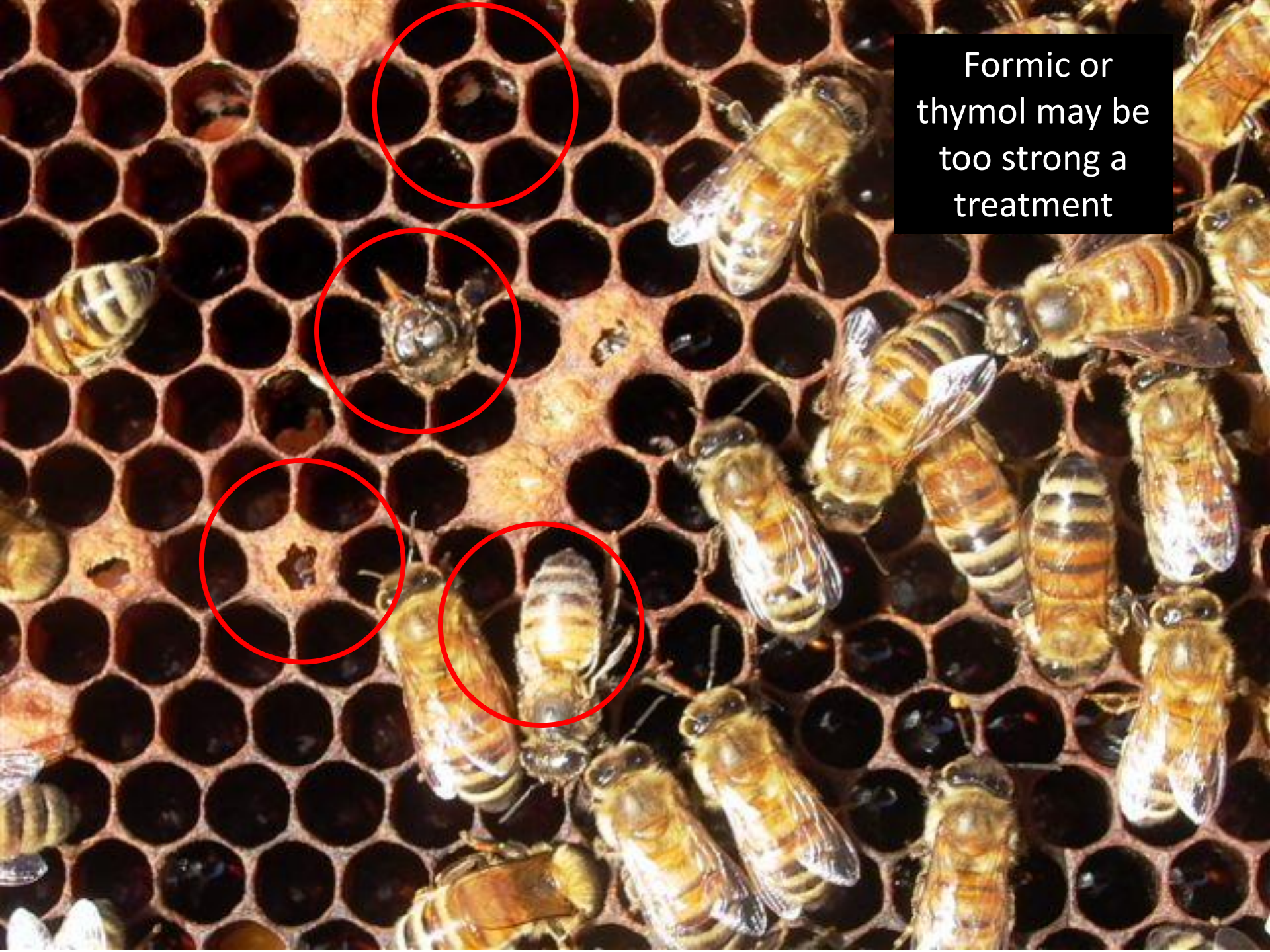


Nosema infection after fall dribble of weak OA, 50mL/hive

Summer Treatment

- ***Can be used on severely mite-stressed colonies to buy time.***
- ***Must be repeated at weekly intervals.***


Colony about to collapse

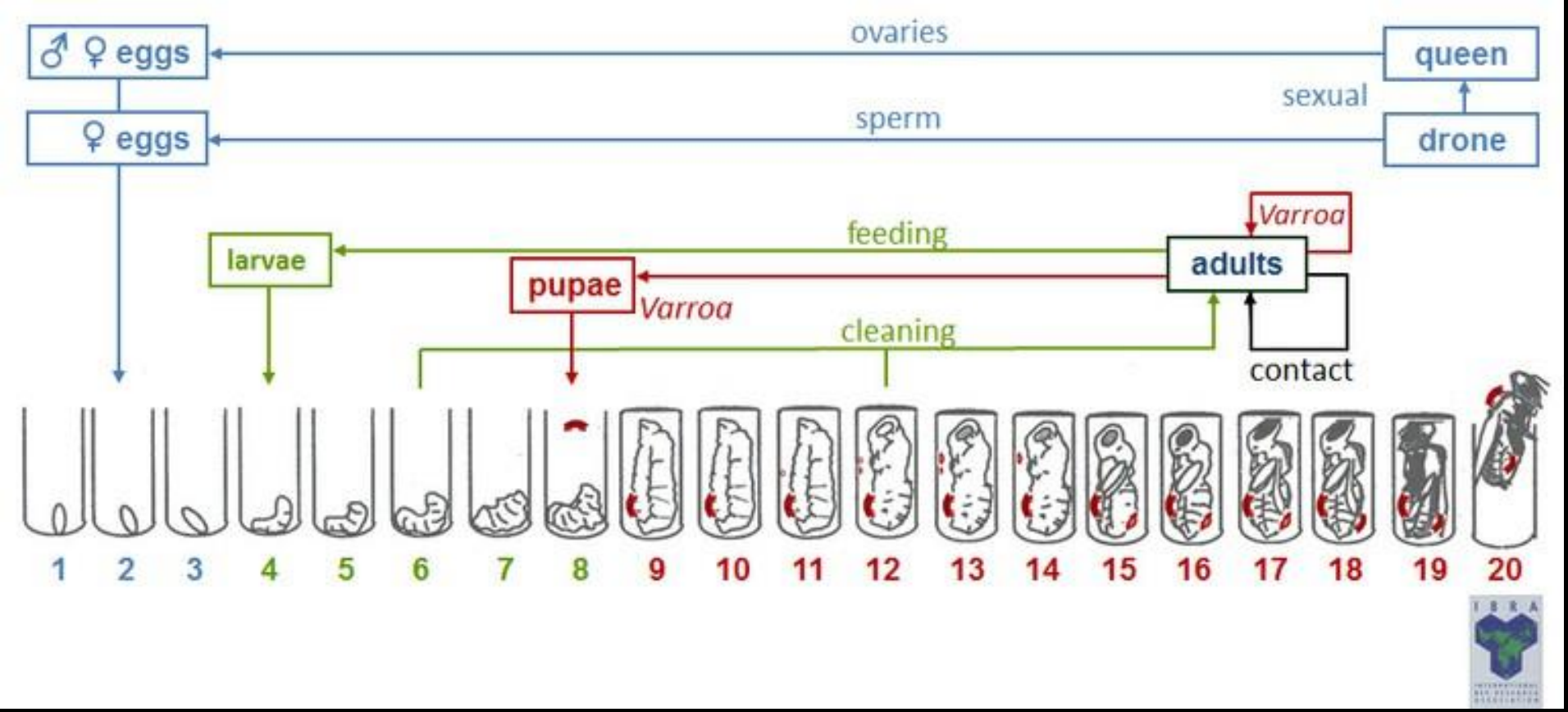

Formic or thymol may be too strong a treatment

Summer treatment—

3 weekly applications.

Around 50% mite reduction.

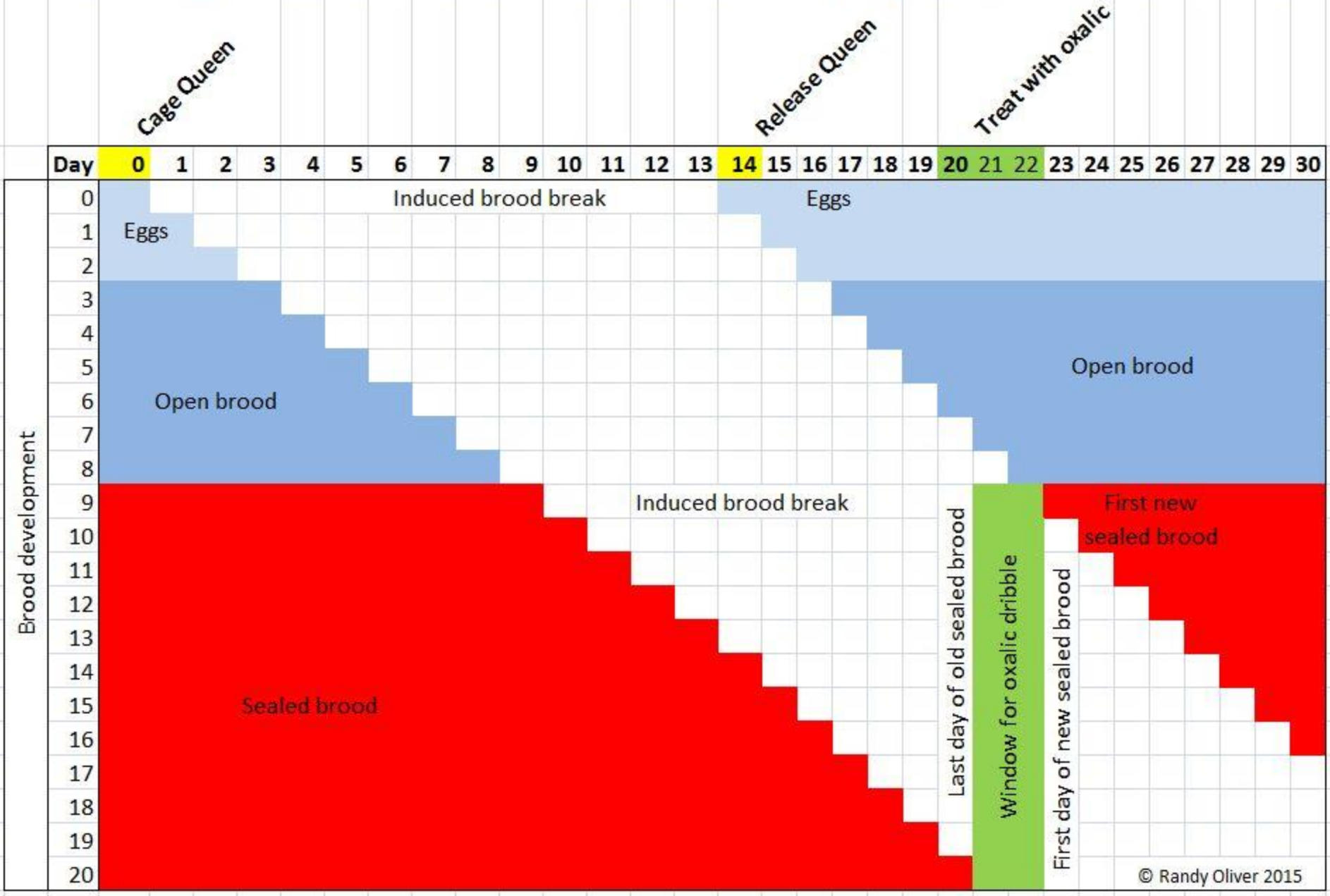
Induced Brood Break



Understand the timing!

Beekeepers in Italy create an induced brood break during late summer by temporarily caging the queen

Creating an induced brood break for oxalic treatment by caging the queen for two weeks.



Cage the queen for 12 days minimum. Then release her. Treat 4-5 days later.

Treat walkaway splits at 20 days.

Combine OA with requeening

Kill the old queen,
insert a queen
cell,
treat with OA 19
days later.

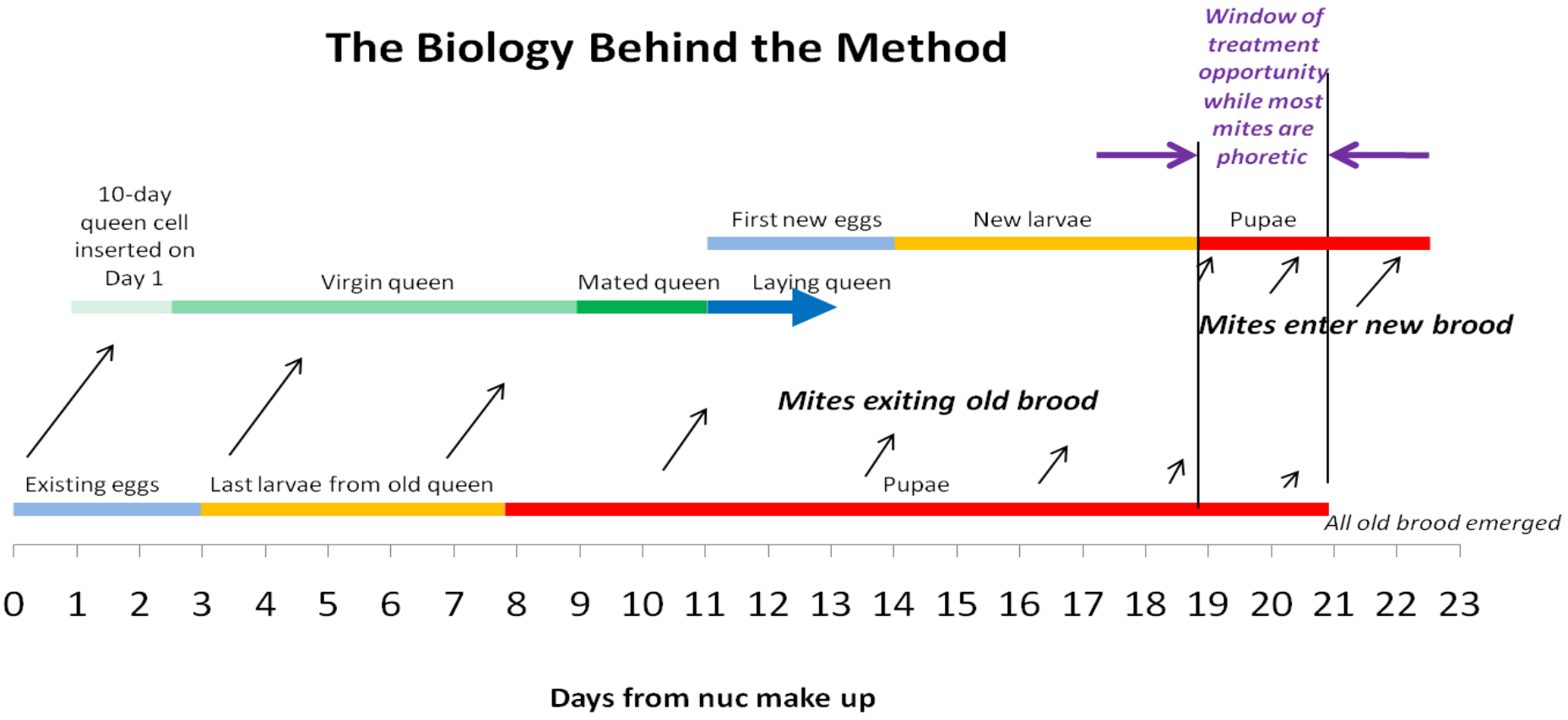
Cage the old queen for 2 weeks,
then remove her and introduce a new queen,
treat with OA 5 days later.

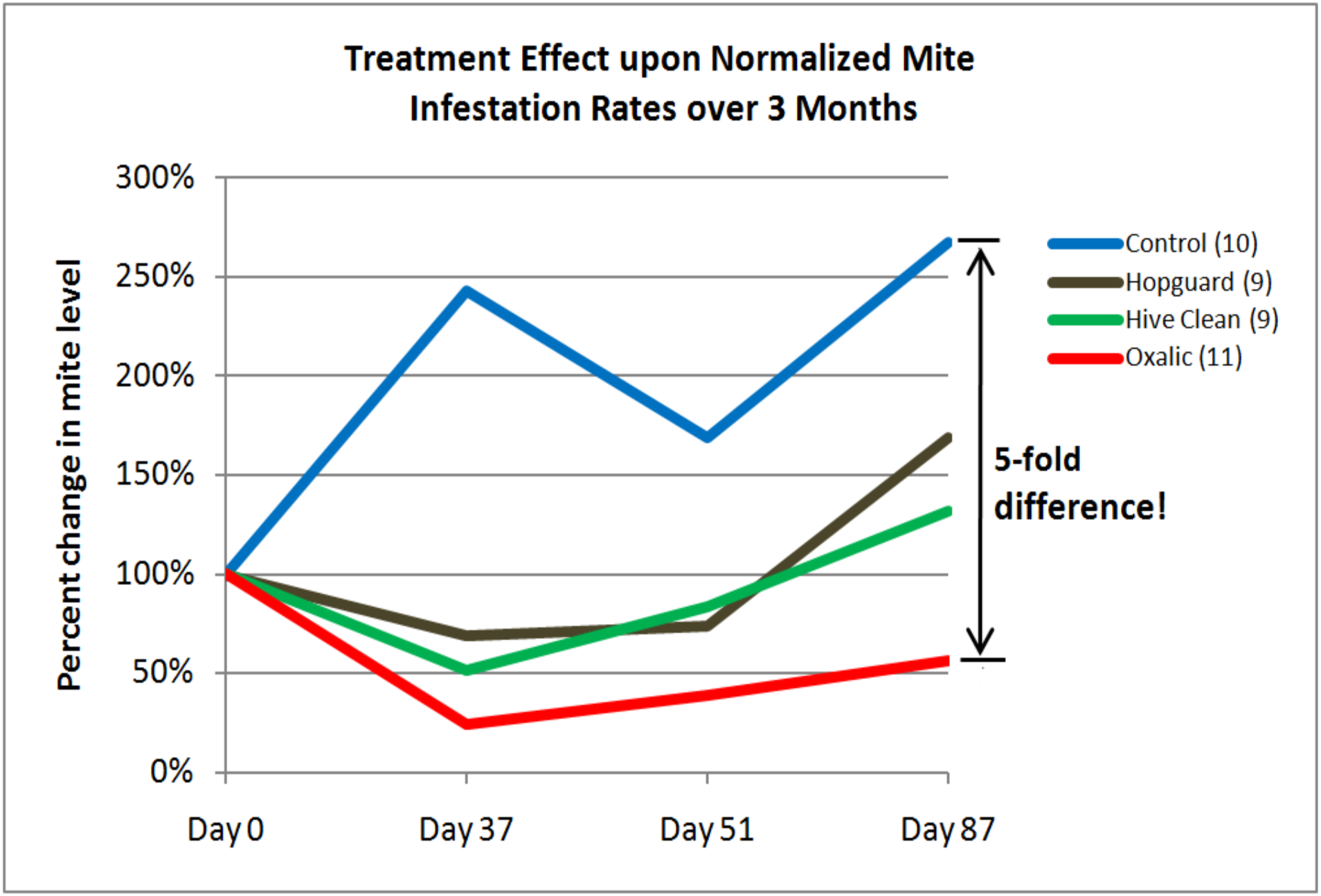
Treatment of Nucs or Packages

A no brainer

Treat package bees or swarms shortly after installation for a "clean start"

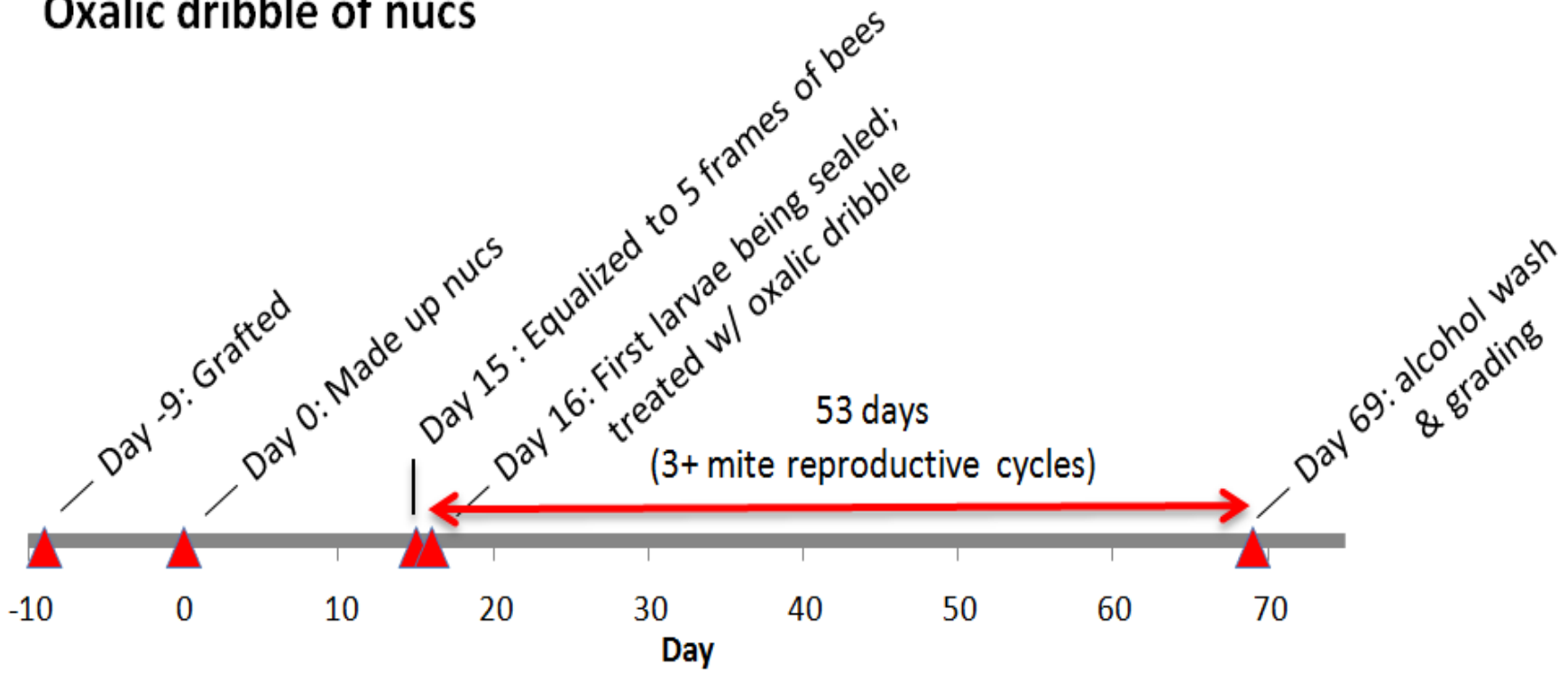
Treatment window for nucs

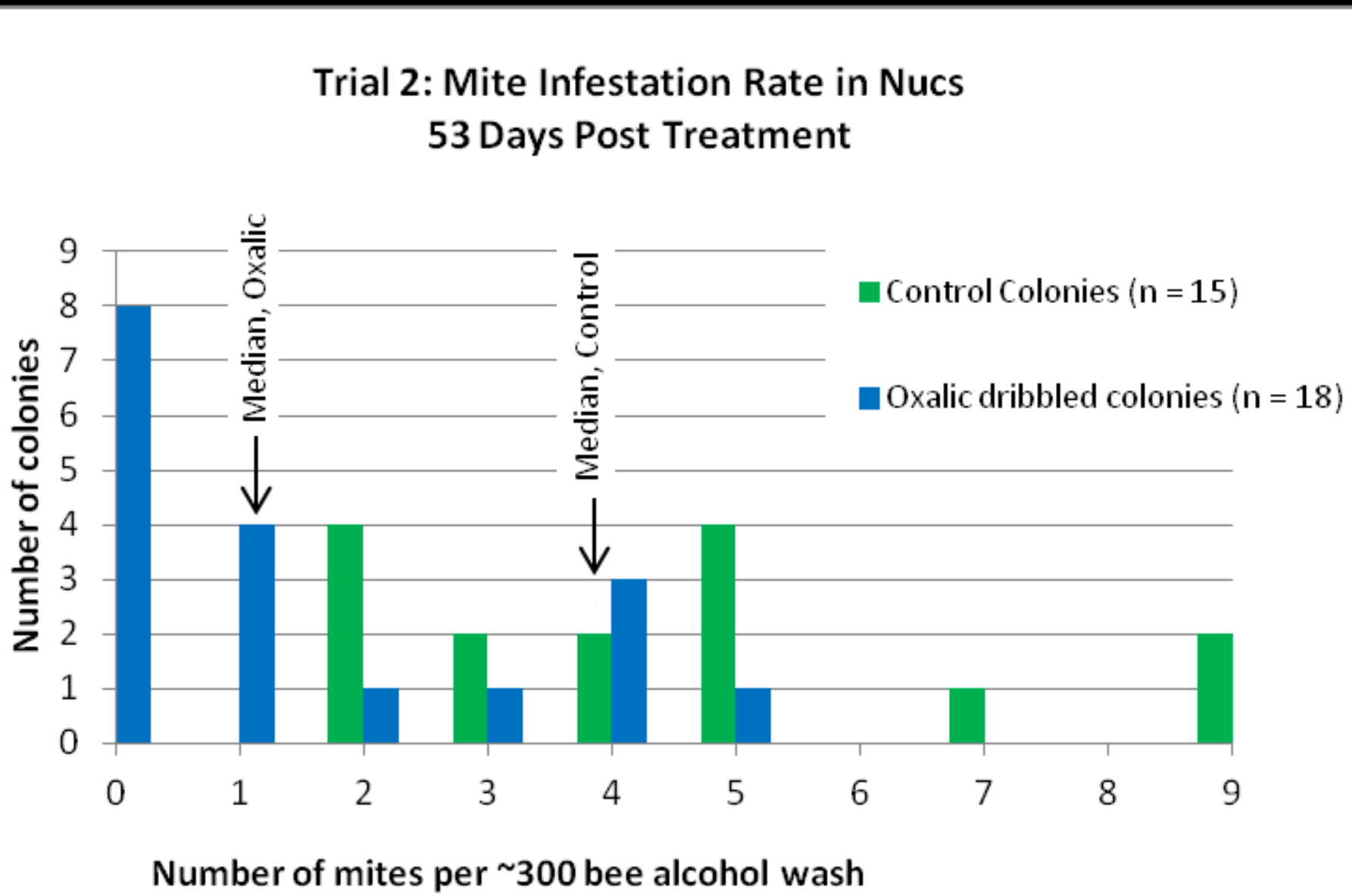


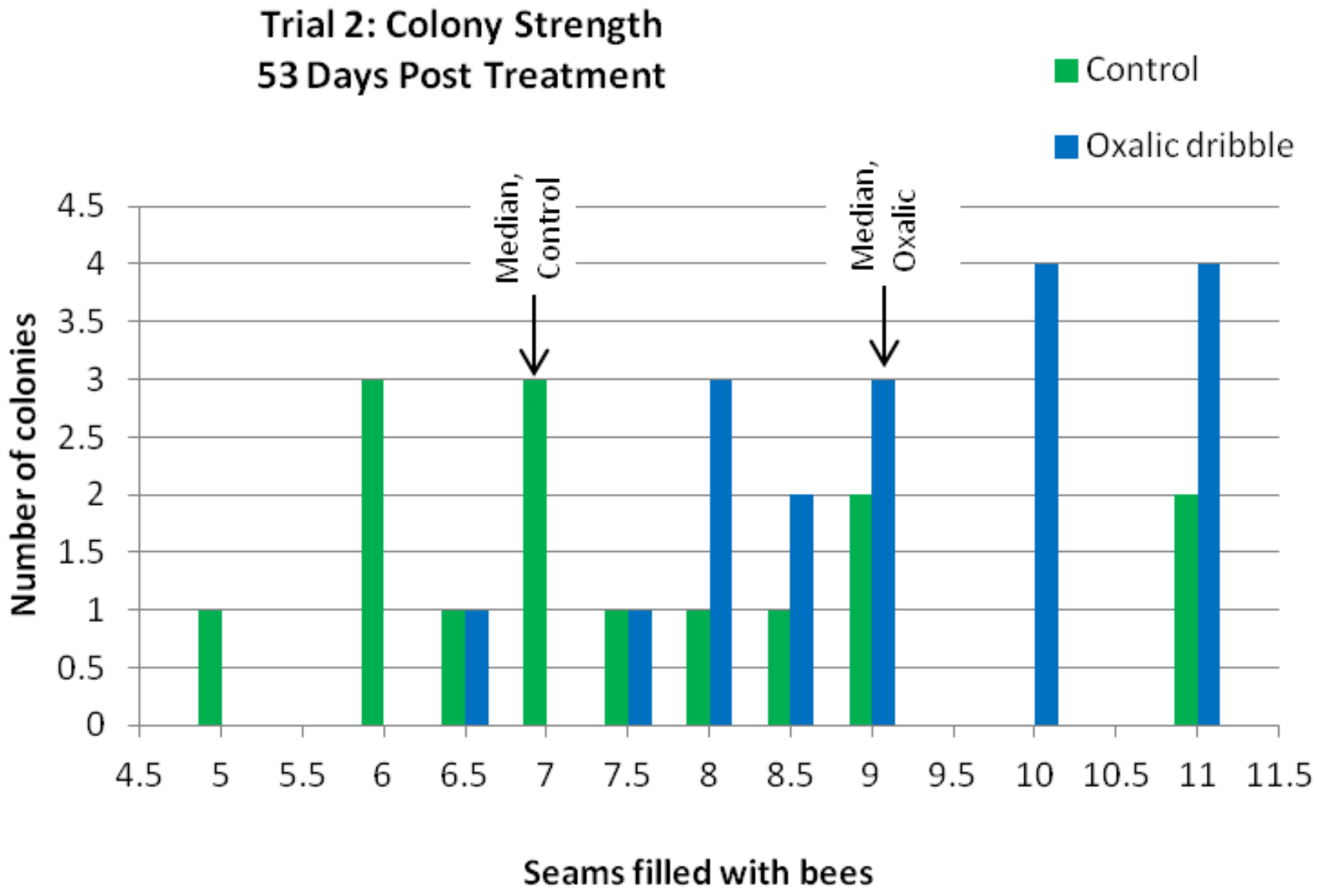

Treatment Effect upon Normalized Mite Infestation Rates over 3 Months
Percent change in mite level
300%
250%
200%
150%
100%
50%
0%
Day 0
Day 37
Day 51
Day 87
Control (10)
Hopguard (9)
Hive Clean (9)
Oxalic (11)
5-fold difference!

Timeline, Trial 2

Oxalic dribble of nucs




Trial 2: Mite Infestation Rate in Nucs
53 Days Post Treatment
Median, Oxalic
Median, Control
Control Colonies (n = 15)
Oxalic dribbled colonies (n = 18)
Number of colonies
0
1
2
3
4
5
6
7
8
9
Number of mites per ~300 bee alcohol wash


Trial 2: Colony Strength
53 Days Post Treatment
Control
Oxalic dribble
Median, Control
Median, Oxalic
Number of colonies
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
Seams filled with bees

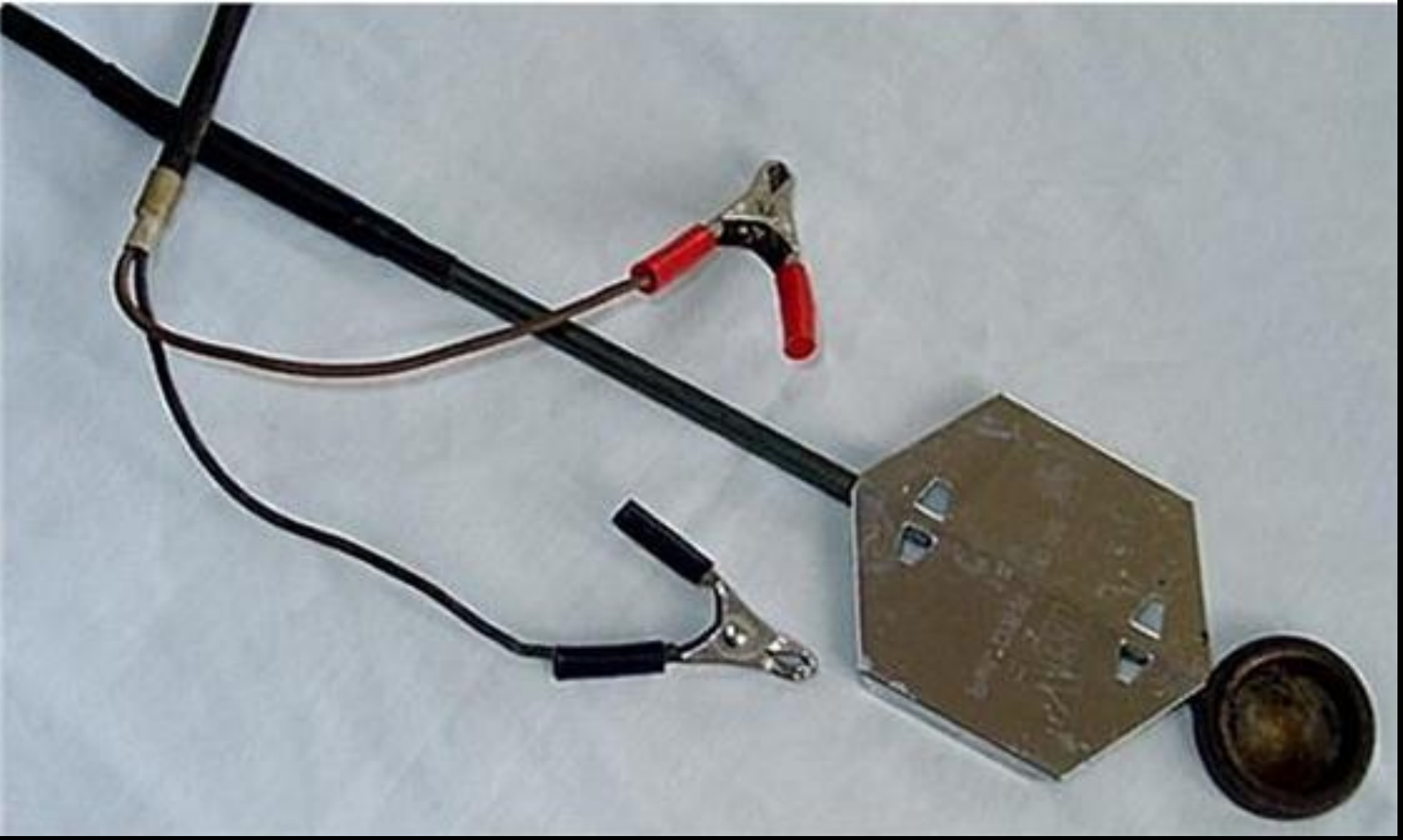
Doesn’t appear to harm queens

Graft #	Queen(s)	No. cells	Day	Graft date	Sealed	Incubator	Nucs by	Early ripe	Typ mate	Typ eggs	Check/oxalic	Nuc yard(s)
			Fri	3/9	3/13	3/16	3/18	3/19	3/28	3/31	4/6	
			Sat	3/10	3/14	3/17	3/19	3/20	3/29	4/1	4/7	
			Sun	3/11	3/15	3/18	3/20	3/21	3/30	4/2	4/8	
			Mon	3/12	3/16	3/19	3/21	3/22	3/31	4/3	4/9	
			Tue	3/13	3/17	3/20	3/22	3/23	4/1	4/4	4/10	
			Wed	3/14	3/18	3/21	3/23	3/24	4/2	4/5	4/11	
			Th	3/15	3/19	3/22	3/24	3/25	4/3	4/6	4/12	

Create a spreadsheet to keep track of dates

Vaporization (Sublimation)

http://www.thekidsmovies.com/movies/showmovie/xtsfgm-OKSALK-AST-BUHARLATIRMA-APARATI-OXALC-ACD-VAPORZER-DENEME-GRNTLER



Useful where winter comes on suddenly.

Simple Varrox vaporizer.

Vaporized oxalic is dangerous!
Wear a respirator.

Other issues:
Cooked bees
Burnt wood or plastic

https://beeinformed.org/2014/02/03/oxalic-acid-fogger-demostration/


Sublimation may be
easier on the bees.

Recently published

Journal of Apicultural Research, 2015
http://dx.doi.org/10.1080/00218839.2015.1106777

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ORIGINAL RESEARCH ARTICLE

Towards integrated control of varroa: 2)comparing application methods and doses of oxalic acid on the mortality of phoretic *Varroa destructor* mites and their honey bee hosts

Hasan Al Toufailia*, Luciano Scandian and Francis L W Ratnieks

Dribble vs. Sublimation

Dribble		Sublimation	
Pros:	High efficacy	**Pros:**	Perhaps higher efficacy
	Very safe to apply		No opening of the hive
	Quick		Can do in freezing weather
	Little equip needed		Perhaps gentler to the bees
			No syrup mixing
Cons:	Requires opening hive	**Cons:**	Vapor fog is hazardous
	May be problematic in freezing weather		Requires specialized vaporizer and energy source
	Easier with helper		Problems with hot tip

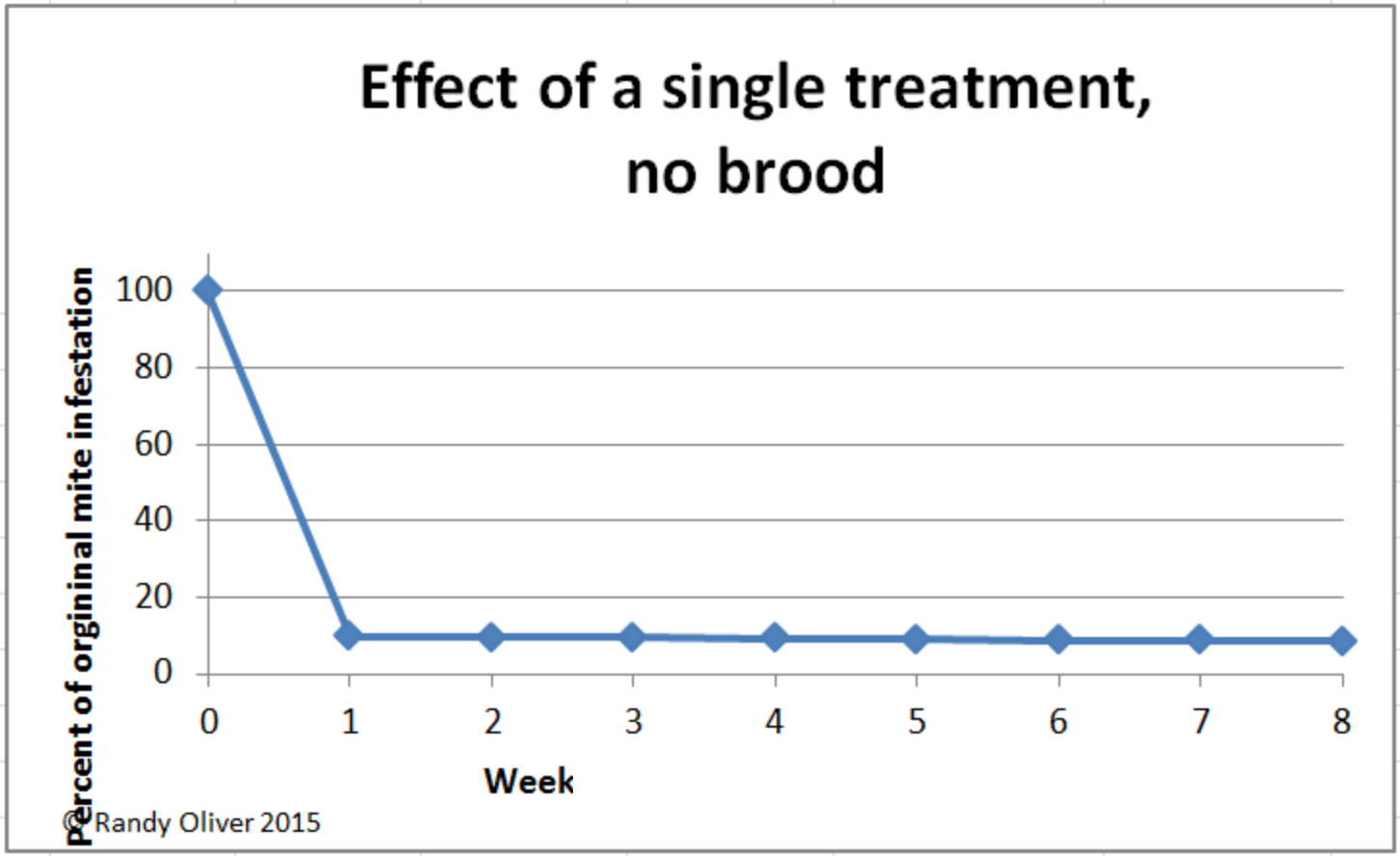
Instructions: type values into for the two yellow cells and hit enter

Percent of full broodnest present **0** **%** A full broodnest with substant

there may be only 50% or less of a full broodnest present. Adjust this value to

Expected weekly kill of the phoretic mites by the treatment **90** **%** fil

See N



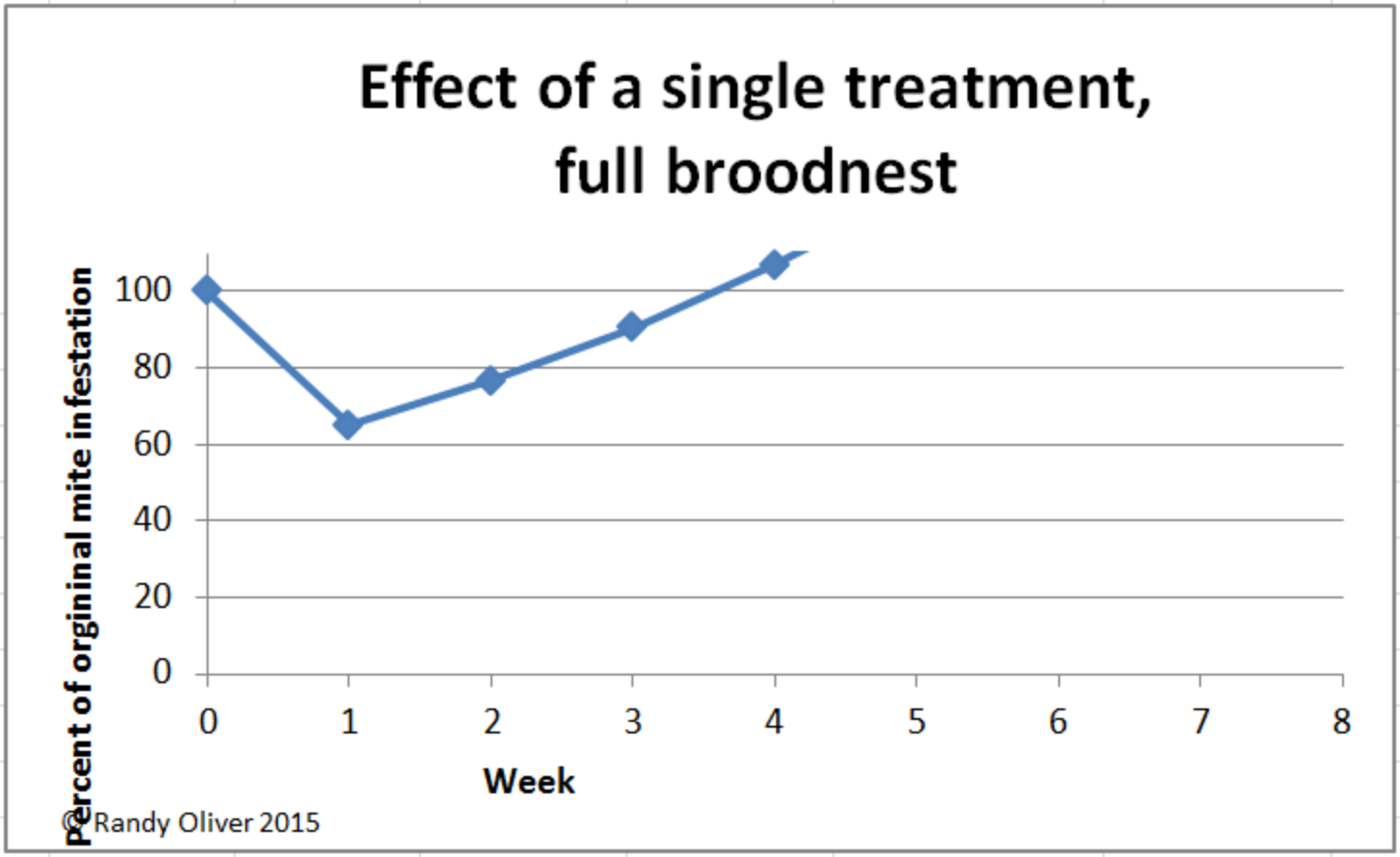
Instructions: type values into for the two yellow cells and hit enter

Percent of full broodnest present **100** **%** A full broodnest with substantia

there may be only 50% or less of a full broodnest present. Adjust this value to

Expected weekly kill of the phoretic mites by the treatment **90** **%** fill

See N



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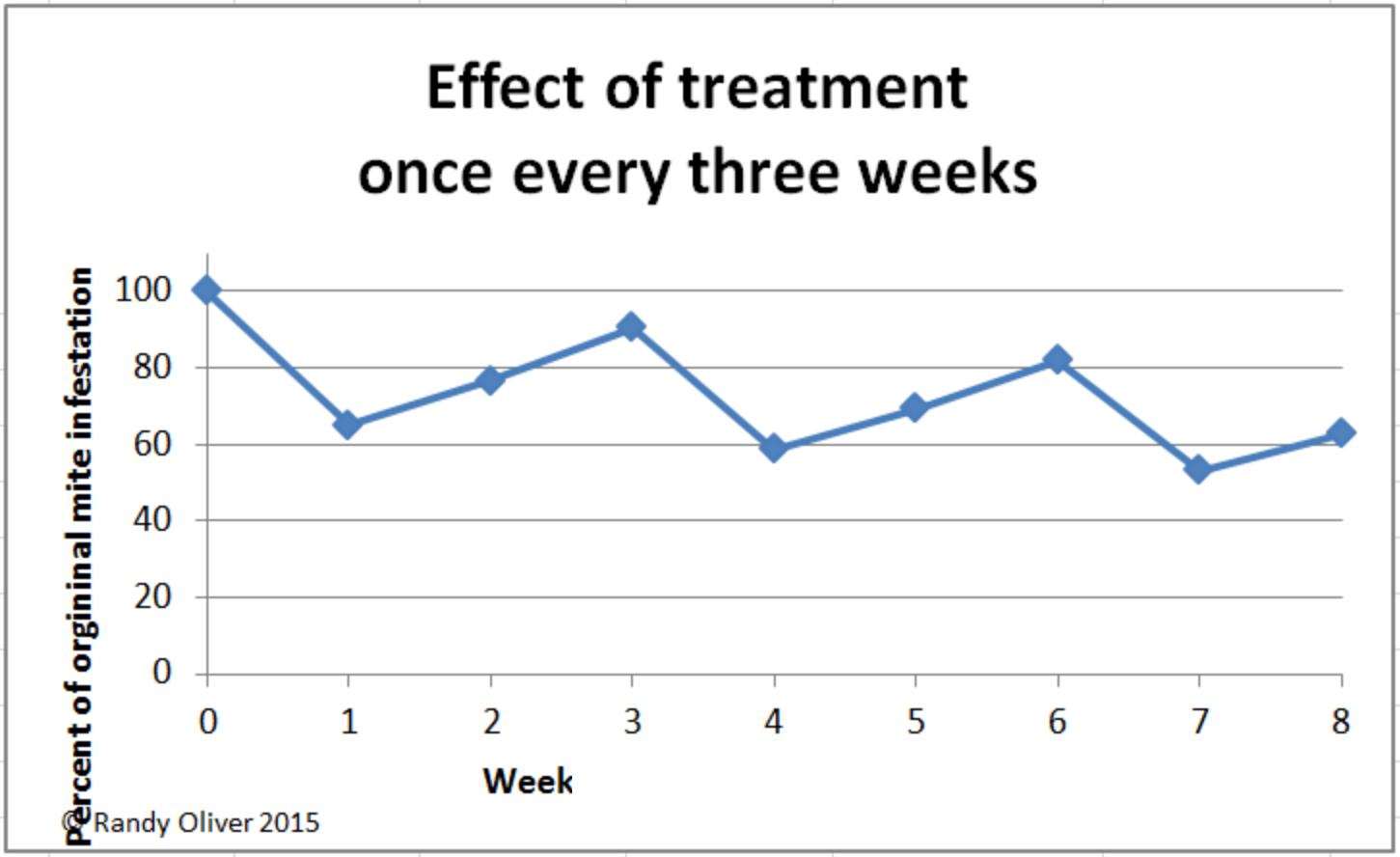
Expected weekly kill of the phoretic mites by the treatment **90** **%** fill

See N



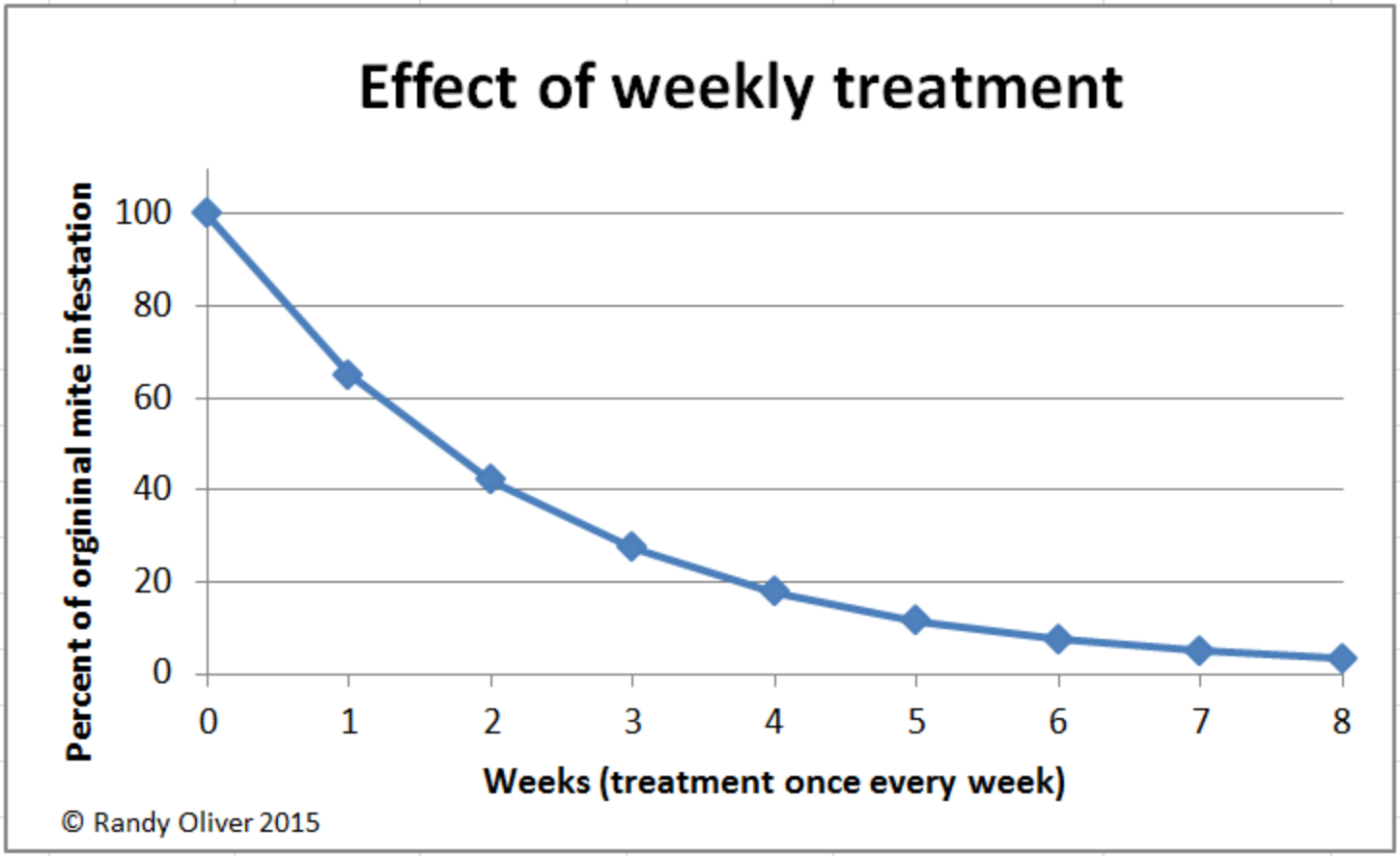
Instructions: type values into for the two yellow cells and hit enter

Percent of full broodnest present **100** **%** A full broodnest with substantial

there may be only 50% or less of a full broodnest present. Adjust this value to yc

Expected weekly kill of the phoretic mites by the treatment **90** **%** fill in

See Not



Another application method

Apidologie

DOI: 10.1007/s13592-015-0405-7

Original article

A new formulation of oxalic acid for *Varroa destructor* control applied in *Apis mellifera* colonies in the presence of brood

Matías Maggi[1,2], Elian Tourn[3,4,5], Pedro Negri[1,2], Nicolás Szawarski[1], Alfredo Marconi[3,4,5], Liliana Gallez[6], Sandra Medici[1,2], Sergio Ruffinengo[7], Constanza Brasesco[1], Leonardo De Feudis[1], Silvina Quintana[8], Diana Sammataro[9], Martin Eguaras[1,2]

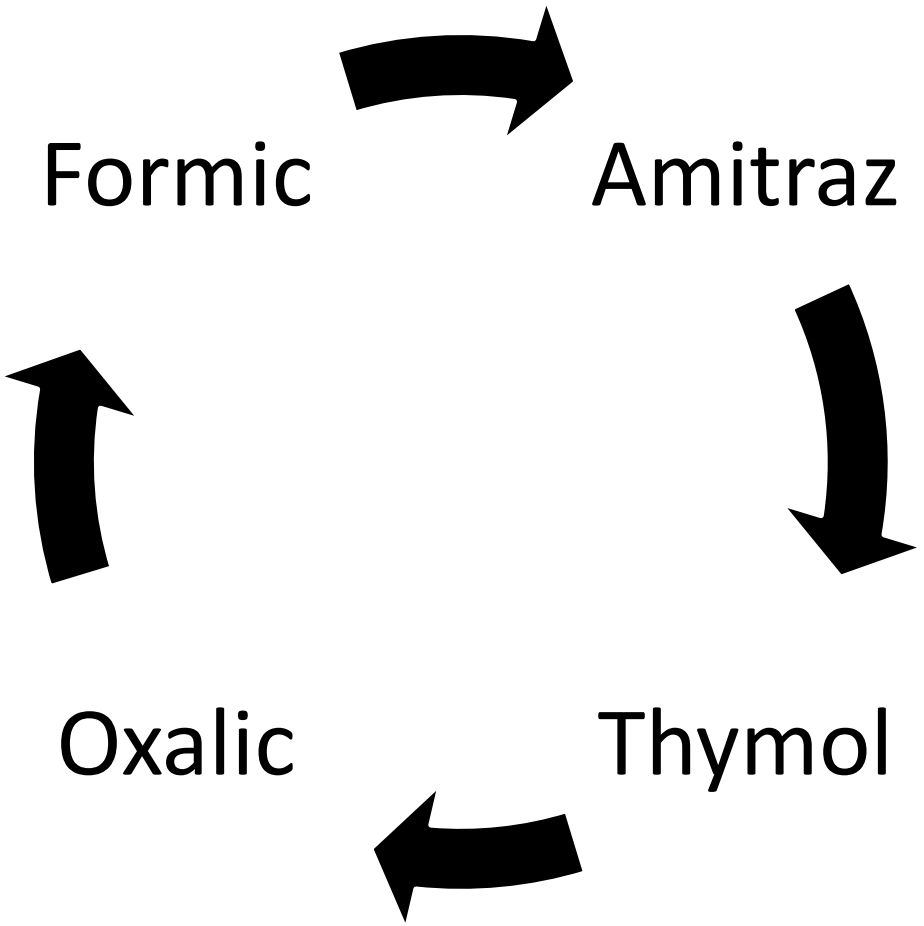
Oxalic/glycerine on cardboard strips.

A Critical Closing Thought

"The only way to halt the development of resistance to a certain product is by interrupting its use in the control strategy."

Lodesani (2009) Limits of chemotherapy in beekeeping: development of resistance and the problem of residues.

Practice some sort of rotation of treatments



Happy beekeeping!

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