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Varroa Doubling Info: Understanding the Boom and Assessing Your Varroa Treatment "Time Purchase"

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Beekeepers have often been surprised at rapid increases in varroa levels. Colonies that were showing few mites several weeks earlier suddenly seem to have high varroa loads. Varroa don't appear out of nowhere. What is the explanation?

The answer can be found in a math riddle: If a jar has bugs in it that are reproducing so fast that they double in number every minute, becomes full at 30 minutes, when was the jar half full? The answer, of course, is 29 minutes, one-quarter full at 28 minutes, one-eighth full at 27, etc. So, the question becomes: How long is a varroa reproduction "minute", and what is the varroa "jar"?

With varroa, the "jar" is the mite load the bees can function with, identified as 2,500 varroa for Great Britain and approximately 3,200 in the US.¹ This is because varroa control should be approached as a brood disease.² The post capping period is 12 days for worker brood.³ If a queen is laying 1,000 viable worker eggs a day, 12,000 developing larvae are under the cap. If there are 3,000 varroa in a colony, one quarter of the brood is at risk. Three weeks later, half the brood in the colony is at risk. Colony collapse is fast approaching, putting it as a major source of infestation for surviving colonies in the area.

VARROA REPRODUCTION TIMELINE WHEN BROOD IS PRESENT, UNSELECTED STOCK

Varroa reproduction: Each foundress mite starts out with 25-30 eggs,⁴ consuming 5 - 6 per reproductive cycle.⁵ In worker brood varroa spends 12 days under the cap, 4-6 days phoretic.⁶ One foundress mite produces one viable female offspring per reproductive cycle,

doubling the varroa load. In drone brood there is 14 days under the cap, 4-6 days phoretic, and 1 foundress varroa produces 2.2 viable female offspring per reproductive cycle, increasing varroa load by 3.2 times.⁷

Result: Due to compounding, by the end of 16 weeks each foundress mite will be responsible for approximately 32 viable female offspring. The varroa "minute" works out to 22.4 days (figure 1), approximately 3 weeks.

Figure 1. Unselected stock chart
16 weeks is 112 days with 5 doubling periods the varroa double every 22.4 days

# varroa	doubling period (22.4 days)	day
100	0 (start)	0
200	1	22.4
400	2	44.8
800	3	67.2
1600	4	89.6
3200	5	112

BUYING TIME

Since eradication of the varroa mite is considered impossible,⁸ when beekeepers use a control product, what they are doing is buying time between treatments. The efficacy of the product determines how much time a treatment will buy (figure 2).

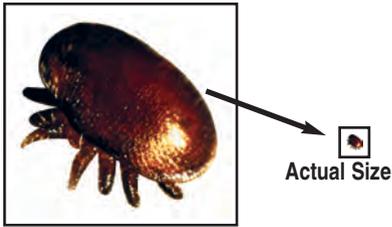
Figure 2. Efficacy of Treatment Time Bought Chart

starting varroa load: 3000 mites working with unselected stock

treatment % efficacy	time bought (weeks)	# of varroa remaining
99.9	30	3
99.8	27	6
99.61	24	12
99.22	21	23
98.44	18	47
96.88	15	94
93.75	12	188
87.5	9	375
75	6	750
50	3	1500
0	0	3000
	-3	6000
	-6.00	doomed

At the 3000 mite treatment threshold, if a treatment has a 97% efficacy, 3.75 months has been bought between treatments. At an 87% efficacy, 2.25 months.

Hard chemicals (fluvalinate – Apistan[®], coumaphos – CheckMite+[™]), which have historically offered close to 100% control, are failing.⁹ Beekeepers are being forced to adopt other management strategies, which may include long-term soft chemical options. Currently available soft chemical



options in the U.S. include Sucroside™, Mite-AwayII™ Single Application Formic Acid Pad, ApiLife Var®, and Apiguard™.

EXERCISE

Here are examples of several varroa treatment products, as assessed by Stanghellini and Raybold for varroa treatment in the fall of 2003, in New Jersey, USA:¹⁰

single deep colonies:

Apistan®: 97%, Sucroside™: 96%, oxalic acid 92%, ApiLife Var®: 91%, and MiteGone™: 79%

double deep colonies:

Apistan®: 95%, Sucroside™: n/a, oxalic acid 93%, ApiLife Var®: 69%, and MiteGone™: 66%

Compare these results with the Figure 2 chart and see how much time you are buying.

Take home message: pay attention to the efficacy of the products you're using. 1) Is what you are using working? 2) Are you buying the time you need to prevent major colony losses? and 3) Skipping a treatment may mean loss of that treatment window and colonies going over thresholds before the next window.

VARROA TREATMENT REGIMEN MODELS:

For commercial beekeepers doing migratory beekeeping an IPM program is difficult to establish. The colony movement alone, with constantly shifting environments and locations, makes monitoring and following through on varying treatment requirements difficult. Most operations run crews to do the work and look for routines by which to function. Even non-migratory beekeepers may not be able to follow through on an IPM program due to the assessment skills required.¹¹

A proven treatment regimen suitable for Northeastern USA is outlined in the Cornell University Master Beekeeper Program, using the Mite-AwayII™ Single Application Formic Acid Pad (MAII),

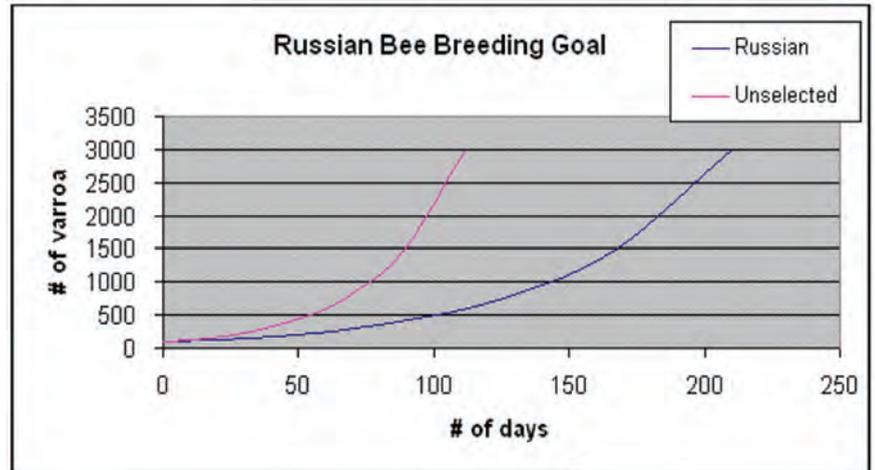


Mite-Away II™ pail of 10 packs

Figure 3. Goal chart

# varroa	doubling period	Russian days to double	Unselected days to double
94	0 (start)	0	0
188	1	42	22.4
375	2	84	44.8
750	3	126	67.2
1500	4	168	89.6
3000	5	210	112

Figure 4.



Varroa mites on brood

where two treatments are applied, one in the spring and one early fall.¹²

NOD Apiary Products, the developer of the MAII pad, outlines a treatment regimen of two treatments per year for Canada and the Northern US, one in the spring and one early fall.¹³ The MAII formulation provides a 93.5% ± 5% control,¹⁴ and has been shown to provide adequate control as a stand alone varroa control product for four years in Canada.^{15, 16}

The southern states and migratory beekeepers may require a different regime. MAII applied three times per year for the three-point migratory route of 1) going to California for pollination to 2) a southern state for colony buildup and to 3) a northern state for honey production,¹⁷ should provide good control. For colonies that stay in the South and experience high temperatures for much of the year, a treatment program including the use of Apiguard™ (efficacy 90-93%¹⁸) may be required.

THE VALUE OF BREEDING PROGRAMS

Attempts are being made to produce

lines of bees that are capable of coping with varroa and tracheal mites. Initially, the goal was to find or develop a “resistant” stock. Most researchers are now using the term “tolerant” stock and are working on stocks that will have the capability to survive longer between chemical treatments.¹⁹

For a comparison to the standard unselected stock let's look at the Russian Bee Importation program goal. The original goal was to increase the time for varroa load to go from 100 varroa to 3,000 varroa from 16 weeks to 30 weeks, when brood is present.²⁰ Thirty weeks is 210 days with 5 doubling periods (the “varroa minute” in our “jar” model), so the mites double every 42 days (figures 3 and 4).

With the Russian bee project goal, the beekeeper would have approximately 7 months between treatments if a treatment has a 97% efficacy, 4.25 months with 87% efficacy, when brood is present.

With varroa, our “doubling minute” is approximately 3 weeks with unselected stock, but this can be extended with selected stock, potentially reducing the number of treatments required.

FOOTNOTES

- ¹ *Mites of the Honey Bee*, various authors, edited by Webster, T.C., and Delaplane, K.S. © Dadant & Sons Inc. 2001, 51 south 2nd St., Hamilton, Illinois, USA, page 234
- ² *ibid*, page 143
- ³ *ibid*, page 140
- ⁴ *ibid*, page 143

- 5 *ibid*, page 140
 6 *ibid*, page 135
 7 *ibid*, page 144
 8 *ibid*, page 229
 9 *ibid*, page 241,
 10 *American Bee Journal*, June 2004, Vol. 144, No.6
 11 *Mites of the Honey Bee*, various authors, edited by Webster, T.C., and Delaplane, K.S. © Dadant & Sons Inc. 2001, 51 south 2nd St., Hamilton, Illinois, USA, page 232
 12 Integrated Pest Management *Varroa destructor* in the Northeastern United States Using Drone Brood Removal and Formic Acid. *The Bee Files*, Cornell University, © Nicholas W. Calderone, Department of Entomology
 13 NOD Apiary Products press release announcing Mite-Away II™ receiving US-EPA Section 3 pesticide registration. April 2005.
 14 Skinner, A., Tam, J., Ross, S. *OBA TTP report for 2003, The Sting, Vol 21 no.4*. Published by the Ontario Beekeepers Association.
 15 VanderDussen, D., 2006, River Valley Apiaries, Stirling, ON Canada, *Testimonials for Mite-AwayII Single Application Formic Acid Pads*
 16 McRory, Doug, Ontario Provincial Apiarist, *Planning Treatments for the Fall, The Sting*, August 2005. Published by the Ontario Beekeepers Association.
 17 VanderDussen, D, presentation to the American Honey Producers Association, January 14, 2006. Synopsis submitted for publication to *The Honey Producer*.
 18 Apiguard™ promotional handout materials, Vita (Europe) Ltd., 21/23 Wote Street, Bassingstoke, Hunts, RG21 7NE, UK.
 19 *Mites of the Honey Bee*, various authors, edited by Webster, T.C., and Delaplane, K.S. © Dadant & Sons Inc. 2001, 51 south 2nd St., Hamilton, Illinois, USA, page 205
 20 Harris, J.W., presentation at the Ontario Beekeepers Association Commercial meeting, Milton, ON, August 2003

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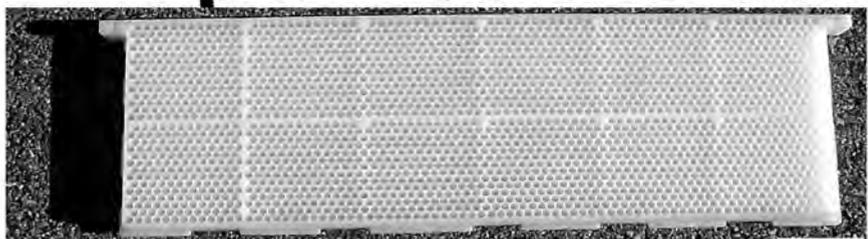
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