

# Using The 50% Formic Acid Fumigator To Control Varroa Mites In Florida, 2006.

Presented to the FL Beekeepers Assoc., Milton, FL, 29 Oct 2006. A Research Grant (\$50,000) from the FL DPI: Jerry Hayes, Chief Apiary Inspector.

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[www.wvu.edu/~agexten/varroa06](http://www.wvu.edu/~agexten/varroa06)

<http://rnoel.50megs.com/2000/index.htm>

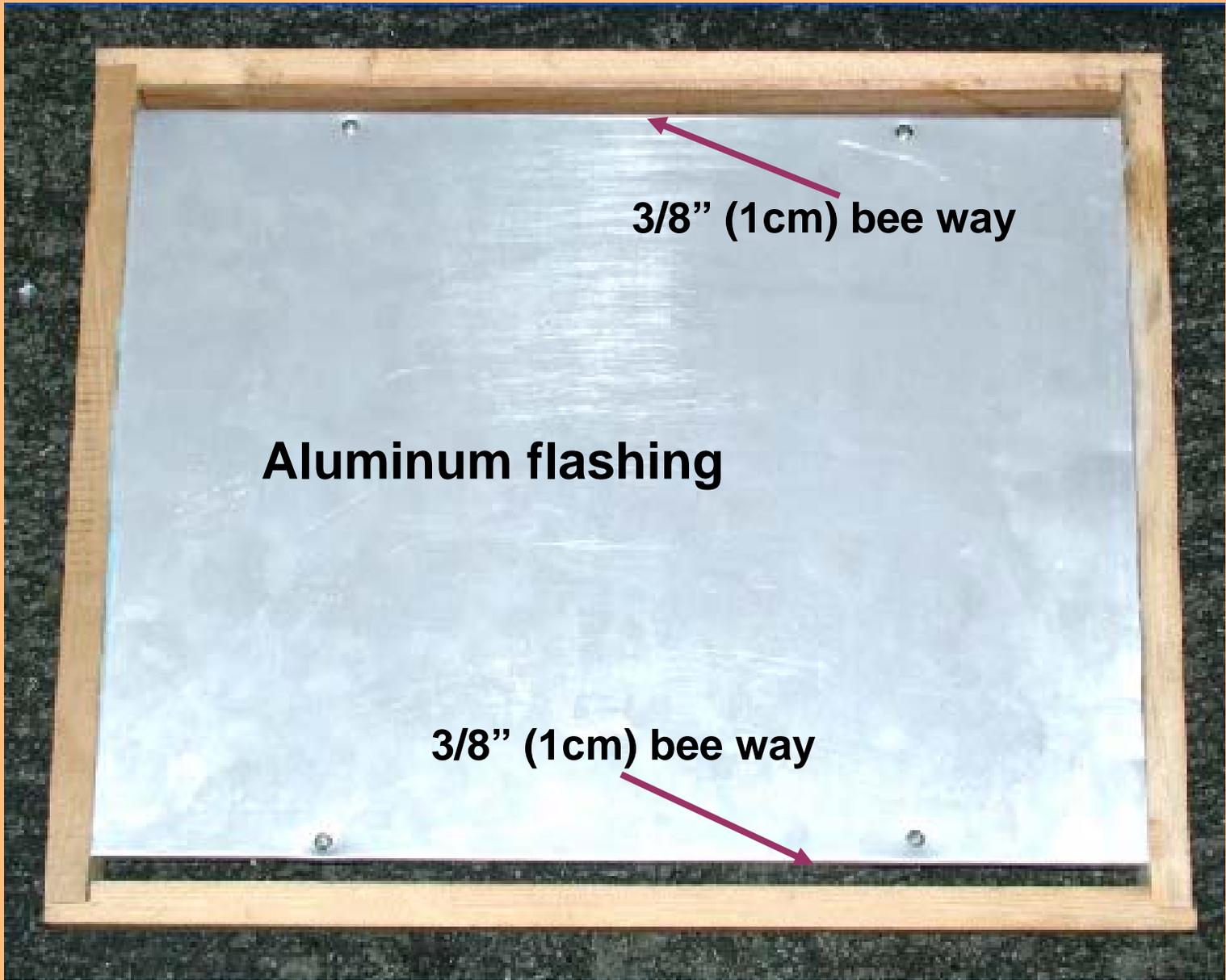
Special thanks to Jerry, Mary and Gary Turner, JJ and Jacob Tilton, John Gentzel, Dimitry Albertese, Alberto Santini, Malcolm Brinson, and Gary Ranker. Without them, this work could not have been done.

See Amrine & Noel, 2006. "Formic acid fumigator for controlling varroa mites in honey bee hives." International Journal of Acarology 32(2): 115-124.



**The 50% Formic Acid Fumigator standing on edge.**

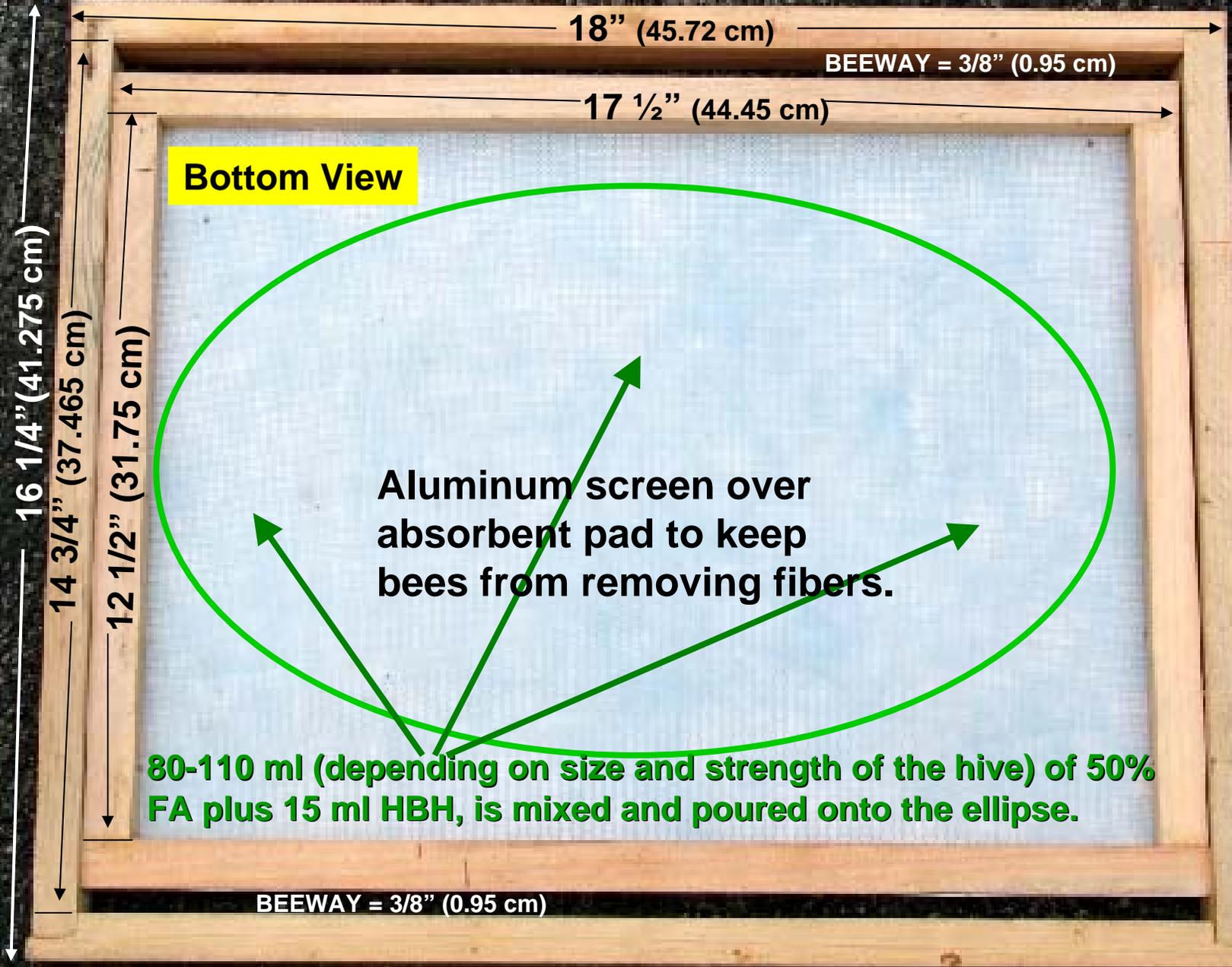
**Top View; outside dimensions: 18" by 16 1/4" (45.72 x 41.275 cm)**



**3/8" (1cm) bee way**

**Aluminum flashing**

**3/8" (1cm) bee way**



**Bottom View**

**Aluminum screen over absorbent pad to keep bees from removing fibers.**

**80-110 ml (depending on size and strength of the hive) of 50% FA plus 15 ml HBH, is mixed and poured onto the ellipse.**

**BEEWAY = 3/8" (0.95 cm)**



**Felt Pads**

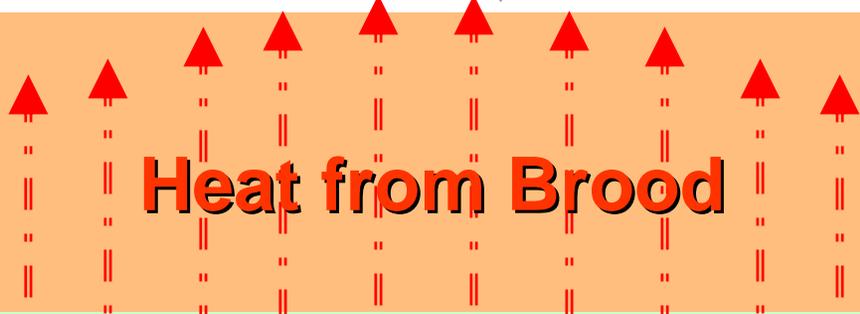
**Soaker Pads**

**We used the white Dri-Line ‘soaker pad’, made by Dri-Line Products, Ltd., 4908 87<sup>th</sup> St., Edmonton, Alberta, Canada (\$400 for 100 m, including shipping). Beekeepers in Canada have treated 1000 colonies with the fumigator this summer and obtained excellent control of varroa mites. They found that the soaker pads work better than our original Kendall® 7174 bed pads. (Treating with liquid formic acid is legal in Canada.)**

**The upper pads are a thick felt found in FL. Bob’s honey mead was poured onto both; the mead flowed more slowly on the felt pads and made a circle 4” diameter. The mead was absorbed more quickly in the soaker pads and made a circle 5” in diameter. We believe that the soaker pads allow for a larger area of evaporation of the 50% FA and that the FA evaporates more quickly. Thicker pads may work better in hot weather.**



Black = Al flashing  
Blue = Absorbent Pad  
Red = Al screen



Heat from Brood

The space [purple lines] below the Aluminum screen [red] is critical to the function of the fumigator. Heat from the brood rises into this 'activation cavity'; the heat causes the 50% formic acid and HBH to quickly evaporate, and the bees vigorously fan this formic-HBH vapor throughout the hive. In three separate experiments (Sep 01, 2000) -10 hives each- when 5 or more frames of brood were present, the temperature in the brood nest was 94° F, in the Activation Cavity - 92° F, and at the entrance - 90° F. By noon the next day, virtually all formic acid had evaporated and the fumigator was removed. Brood cells were opened and nearly all mites were dead; a few bee brood were killed; only a very few varroa invading food at the bottom of the cell were still alive.



**Cleat with entrance reduced to 3.5" x 3/8" (7.5 x 1 cm) at the center.**

# DRONE CELLS

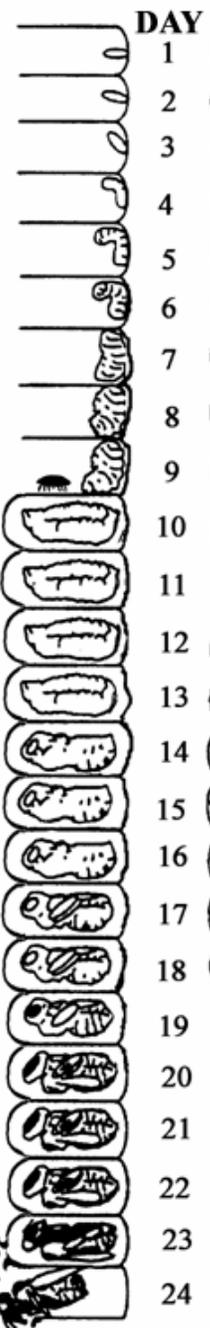
KEY:

	Adult Female
	Adult Male
	Egg
	Protonymph
	Deutonymph ♀
	Deutonymph ♂

Mite Survival in Drone Cells:

Immatures:	0
1 <sup>st</sup> female	98%
2 <sup>nd</sup> female	94%
3 <sup>rd</sup> female	84%
4 <sup>th</sup> female	76%
5 <sup>th</sup> female	63%
Male	0

Capped for 13 or 14 days.



# WORKER CELLS

Mite Survival in Worker Cells:

Immatures:	0
1 <sup>st</sup> female	94%
2 <sup>nd</sup> female	38%
3 <sup>rd</sup> female	1.3%
Male	0

Capped for 13 days.

Refresher on Varroa Mite Development:  
reproducing mites are sealed in brood cells for 13 or 14 days.

## **Application:**

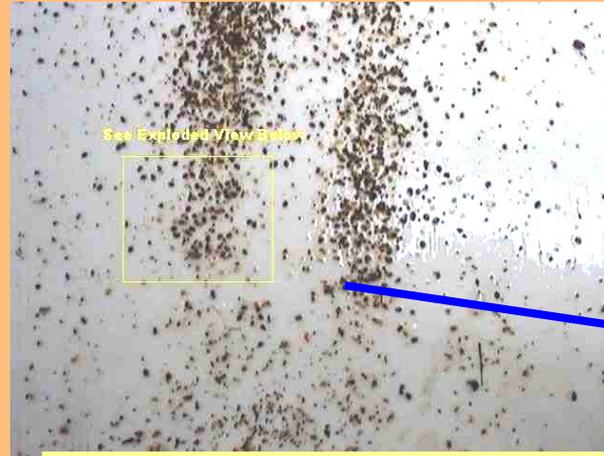
- 1. Ambient Temperature should be 60° to 94° F (15.5-34.4° C).**
- 2. Ideally, apply the treatment between 1 & 6 PM.**
- 3. Manage all brood frames in one or two bottom brood chambers.**
- 4. Depending on colony size, add 80-110 ml (2.6-3.3oz) of 50% FA solution to container, then 15 ml (1/2 oz) of Honey-B-Healthy (to prevent queen loss), mix thoroughly, pour onto absorbent pad in fumigator. Place above the upper brood chamber. Do not use excessive amounts of FA.**
- 5. Tape all openings shut. If you are using screened pallets, replace with solid bottoms or cover and seal the screen with plastic film, aluminum foil, or newspapers.**
- 6. Reduce the entrance to 3.5'' x 3/8'' (8.9 x 1cm) at center.**
- 7. Remove fumigator the next day between 9AM & 6PM. Open capped drone cells to determine efficacy.**

**In most cases, in WV & MD, only one treatment will be needed per season. We often go two seasons between treatments, depending on the number and closeness of neighboring infested colonies, the number of incoming mites from dying colonies, number of robbing bees foraging on declining colonies, and number of drifting drones.**

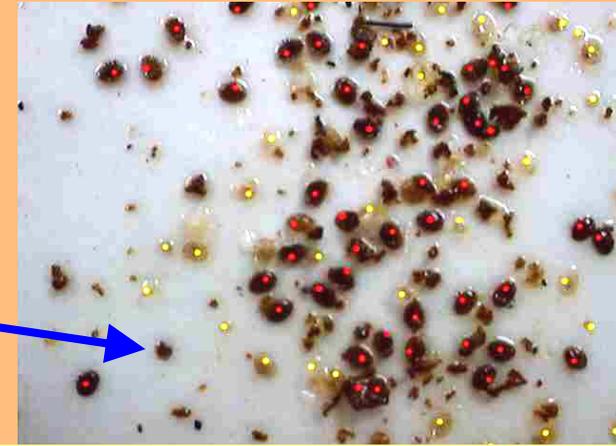
**Results of Using the 50% Formic Acid Fumigator: top three pictures show initial treatment on 09/12/2000. Bottom two pictures show second treatment on 09/28/2000.**



**Old  
Style  
Fumi-  
gator**



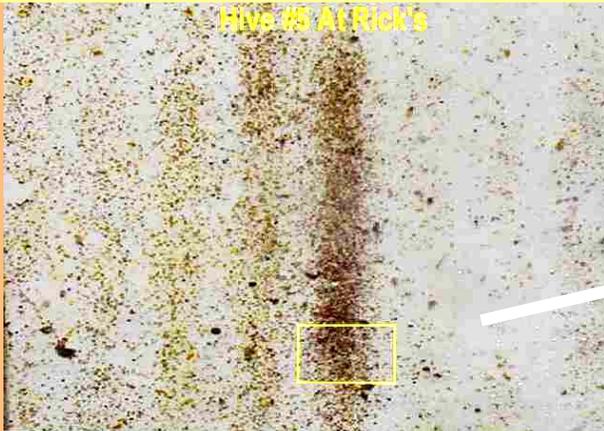
See Exploded View Below



**Test Hive #5 Rick's; 12Sep00.**

**Results Hive #5, Rick's. Close-Up Hive #5, 49 mites.**

## **Second Treatment 13 Days Later:**



Hive #5 At Rick's



**Rick's Hive #5 30, Sep 2000.**

**Exploded View, 30 Sep 2000, 8 mites.**

**50% Formic Acid  
Fumigator in FL,  
DPI 'Church Bee  
Yard', 3-4 Apr 06.**



A person wearing a light-colored lab coat and dark pants is standing outdoors, using a hydrometer to measure the specific gravity of a liquid in a beaker. The hydrometer is partially submerged in the liquid, and the person is looking at the scale. The background shows a grassy area and a wooden fence. The text at the bottom of the image reads: "Checking the specific gravity of the 50% formic acid; it needs to be 1.110."

**Checking the specific gravity of the 50% formic acid; it needs to be 1.110.**

Fumigator applied at 9:15 am, 3 April, 2006, 90 ml of 50% Formic Acid and 15 ml of Honey-B-Healthy.





**Entrance reduced.  
A solid bottom  
board was used on  
this hive; the  
screened bottom  
board is used as a  
trap for discarded  
bees and brood.**

Entrance reduced. A piece of a tree branch was placed in the entrance. The normal entrance reducer was left in Morgantown.



The fumigator was removed at 8:33 am, on 4 April 2006 (after 23 hrs, 18 minutes).

Note the handful of dead, young emerged workers. This is a sign of a successful treatment.





**Small hive  
beetles were  
unaffected by  
the treatment  
(on the bottom  
board).**



**200 worker and drone brood were removed from capped cells; 170 varroa mites were found and only 2 were alive (in one cell). Another 69 varroa mites were found dead on the bottom board:  $237 / 239 = 99.2\%$  mortality.**

A wooden tool case is shown lying flat on a concrete surface. The top surface of the case is densely covered with hundreds of small, white, oval-shaped mites. Some mites appear dark brown or black, indicating they are dead. The mites are scattered across the entire surface, with some clusters and many individual specimens. The background shows a concrete ground with some debris and a metal latch on the bottom edge of the case.

98 dead varroa mites are visible on the tool case.

A photograph of two men standing outdoors in front of a white pickup truck. The man on the left has a goatee and is wearing a light green short-sleeved button-down shirt. The man on the right has a mustache and is wearing a light-colored long-sleeved button-down shirt. Both are smiling. The background shows green trees and a clear blue sky with some clouds. The truck is a white pickup with a black bed liner.

**David  
Westervelt**

**David  
Webb**



**David  
Webb**

**Jerry  
Latner**

**Jerry  
Hayes**

**Ellen  
Dyck**

**Hi Jim,**

**We went back and checked on the hive Friday [7 April] about noon to see if the hive was ok, It did show some brood damage, not too bad. There were young bees emerging out with dead mites in the cells so that made me HAPPY. The brood damage may have been from the mites or that the hive was starving???**

**We did find eggs, so it has a Queen.**

**David A. Westervelt  
Environmental Specialist I  
Apiary Research  
Bureau of Plant and Apiary inspection  
Florida Division of Plant Industry**

## **Treatment of 10 colonies, 15 August, 2006**

**Location: Mr. Hope's property, just west of Cocoa, FL.**

**We were concerned that hot weather in August would result in poor treatments, with the FA driving the majority of the bees out of the hives.**

**Colonies were set on Aluminum foil pressed over the screened pallets, 4 colonies per pallet, except for the last two. The foil was applied a week before when the sticky boards were applied and acted as a satisfactory barrier to the Formic Acid and prevented its untimely loss. The sticky boards were removed and fresh boards inserted prior to treatment. Each entrance was reduced to 3.5 inches by 3/8th inch.**

**Temperature was 94° F., RH 58.7%, partly cloudy, intermittent E. wind at 5 to 10 mph. Treatment began at 13:30: 90 ml of 50% FA was mixed with 15 ml of Honey-B-Healthy® (Spearmint & Lemon Grass essential oils to prevent queen loss) and the solution applied to the center of the fumigator.**

**The fumigators were removed the next day, 16 August 2006, and mite counts were recorded from 100 sealed drone cells.**

**Dr. Dennis Englesdorp [PA Apiarist, <http://www.nhb.org/info-pub/month/2005/1205.pdf>] showed that mortality in worker cells and on adult bees was higher than in drone cells when he tested our 50% formic acid fumigator for a National Honey Board Grant (see also, their July 2006 monthly report and earlier summaries).**

**The contents of forty sealed drone cells were placed into 80% ethanol and the cell swabbed with a small brush to obtain all immature mites, larval skins and other debris. Alcohol washes of about 1/3 pint of adult bees were taken 7 days prior to treatment, at the time of treatment, and immediately following treatment. Colonies 7 and 8 proved to be queenless the next day; they were queenless before the treatment. No other queens were lost. Hive beetles were present in several of the hives. We found hive beetle eggs inside some of the sealed, drone brood cells. Hive beetles were unaffected by the treatment.**



**Placing foil over screened Pallet, 7 Aug 2007.**

**Treatment of 10 colonies, 15 Aug 2006.  
Note bees gathering on the front of the  
colonies. If too much FA is used, they will  
all exit the hive. (Bob Noel in red; Dave  
Webb on the right).**





**Control hives  
(water & HBH).**

**Pulling drone brood, counting live and dead mites in control colonies. (Left to Right, David Webb, Bob Noel and Gary Turner).**





**Hive beetle eggs were found in many sealed drone cells.**





**The sky was full of bees during our treatments...**



**Hive Beetle larvae in hive '7FA' on 23 August 2006, 8 days post-treatment.**

# RESULTS:

Ten hives treated with 50% formic acid, 1:30pm, 15 August, 2006.

Mite counts on 16 August, 2006, from 100 capped drone cells per hive:

	Alive	Dead	Total	%Mortality	#Cells Inf.	Alcohol Rolls.
FA1	6	42	48	87.5	16	3
FA2	2	45	47	95.7	23	3
FA3	0	79	79	100	23	2
FA4	0	66	66	100	45	0
FA5	5	36	41	87.8	20	-
FA6	3	72	75	96	28	4
FA7	1	6	7	85.7	3	0
FA8	8	27	35	77.1	16	2
FA9	0	70	70	100	34	6
FA10	1	25	26	96.1	15	3
	26	468	494	92.59	22.3	2.3
Total mite	494	94.73684	588.7368	Range: 72.1 to 100%.		
		<b>Average Mortality</b>	<b>92.59</b>	<b>IN CAPPED DRONE CELLS.</b>		

## Descriptive Statistics:

		<i>Column 1</i>	<i>Column 2</i>
<b>Test Hive</b>	<b>%Mortality</b>	<b>Mean</b>	<b>92.59</b>
<b>FA1</b>	<b>87.5</b>	<b>Standard Error</b>	<b>2.44</b>
<b>FA2</b>	<b>95.7</b>	<b>Median</b>	<b>95.85</b>
<b>FA3</b>	<b>100</b>	<b>Mode</b>	<b>100.00</b>
<b>FA4</b>	<b>100</b>	<b>Standard Deviat</b>	<b>7.71</b>
<b>FA5</b>	<b>87.8</b>	<b>Variance</b>	<b>59.40</b>
<b>FA6</b>	<b>96</b>	<b>Kurtosis</b>	<b>0.02</b>
<b>FA7</b>	<b>85.7</b>	<b>Skewness</b>	<b>-0.90</b>
<b>FA8</b>	<b>77.1</b>	<b>Range</b>	<b>22.90</b>
<b>FA9</b>	<b>100</b>	<b>Minimum</b>	<b>77.10</b>
<b>FA10</b>	<b>96.1</b>	<b>Maximum</b>	<b>100.00</b>
	<b>92.59</b>	<b>Sum</b>	<b>925.90</b>
		<b>Count</b>	<b>10.00</b>
		<b>Confidence Level</b>	<b>4.78</b>

**Ten control hives: five with 90 ml of water, five with 90 ml water and 15 ml of Honey B Healthy<sup>®</sup> (less Spearmint EO).**

	<b>Alive</b>	<b>Dead</b>	<b>%Mortality'</b>	<b># cells</b>	<b># Cells In</b>	<b>ETOH</b>
<b>C1</b>	<b>180</b>	<b>0</b>	<b>0</b>		<b>54</b>	<b>14</b>
<b>C2</b>	<b>116</b>	<b>3</b>	<b>2.5</b>		<b>42</b>	<b>8</b>
<b>C3</b>	<b>156</b>	<b>0</b>	<b>0</b>		<b>66</b>	<b>10</b>
<b>C4</b>	<b>24</b>	<b>0</b>	<b>0</b>		<b>24</b>	<b>7</b>
<b>C5</b>	<b>22</b>	<b>0</b>	<b>0</b>		<b>8</b>	<b>1</b>
<b>C6</b>	<b>6</b>	<b>0</b>	<b>0</b>		<b>4</b>	<b>3</b>
<b>C7</b>	<b>14</b>	<b>0</b>	<b>0</b>		<b>5</b>	<b>4</b>
<b>C8</b>	<b>23</b>	<b>0</b>	<b>0</b>		<b>20</b>	<b>3</b>
<b>C9</b>	<b>44</b>	<b>1</b>	<b>2.2</b>		<b>12</b>	<b>8</b>
<b>C10</b>	<b>7</b>	<b>1</b>	<b>12.5</b>		<b>7</b>	<b>5</b>
<b>Total</b>	<b>592</b>	<b>5</b>	<b>1.72</b>		<b>24.2</b>	<b>6.3</b>
<b>Tot # Mites</b>	<b>597</b>					
		<b>0.837521</b>				
<b>Overall % Mortality</b>		<b>0.83%</b>				

**Average control mortality was 1.72%**  
**Overall control mortality was  $5/597 = 0.83\%$**

## **Excessive Dose of 50% FA in hot weather:**

**Test on 74 colonies, 12 May 2006:**

**At 5:00 PM, 92 degrees & high humidity (75%?) we applied 100 ml of 50% FA – HBH, mixed 10 to 1, to 74 single, deep brood chambers.**

**The bees left the hives as soon as we put the fumigators on. They poured out the reduced entrance, much faster than the last test. We pulled the fumigators the next afternoon. In thirteen hives the bees were gone; the others still had a lot of bees hanging out. We found one colony piled up on some high grass 15 feet from the hives. We did not see a lot of mites on the masonite that we placed on the bottom: ether roll tests were done on two hives and found 15 mites in one and 8 in the other.**

**Comments: In hot weather, with single deep colonies, a dose of only about 70-80 ml should have been used.**



**Bees left the hives as soon as the treatment was put on.**

## FA leaking out the Bottom:

10 Oct 2006, several colonies were treated on screened pallets. Masonite sheets were placed on the screen during fumigation to act as a seal. 100 ml 50% FA + 15 ml HBH-L was put onto each fumigator.

Results: about 80% of the varroa mites were still alive in the brood cells.

The next day the masonite boards were found to have about an 1/8<sup>th</sup> inch gap all around the perimeter. Bob Noel: “Use of masonite sheets to seal screened pallets allowed for 6.25 sq. in. of additional opening: 50" x .125" = 6.25 sq. in. [50" = the perimeter of the masonite not fitting by 1/8th inch]. 6.25" + 1.3" = 7.5 sq. in. A normal colony opening is 11.06 sq. inches (14 3/4" by 3/4". Our reduced entrance is 3.5" x 3/8" = 1.31 sq inches).” So, the area of the masonite leak was almost 5 times larger than our typical reduced entrance.

Note: Newspapers may make a good bottom seal for colonies on screened pallets. Always be sure colonies are sealed.

**Treatment of 20 colonies, Duda Ranch, Melbourne, FL, 23-24 October 2006. Colonies were double deep brood chambers and had new solid pallets in place of screened pallets; however some of the wood separated and tape was applied to make a seal. Temperature was 80 F and the RH was 33.5%; a cold front came through on the 23<sup>rd</sup>; there was a steady brisk wind from the north. We replaced sticky boards, evaluated colony strength and conducted an alcohol wash on each colony. Gary Ranker made video recordings of the treatments. John Gentzel and two workers, Dimitry Albertese & Alberto Santini, helped with the tests. We applied 110 ml of 50% formic acid with 15 ml of Honey-B-Healthy to each treatment colony beginning at 5 pm. All openings were sealed with tape.**

**Fumigators were removed beginning at 10am on 24 October (after 17 hours). The temperature at 10 am was 60 F, RH was 32%; brisk wind from the north. New sticky boards were applied, alcohol wash done, and 100 drone or worker cells opened and live and dead mites tallied for each colony. Three teams opened and tallied cells: David Webb and Malcolm Brinson, Jerry and Mary Turner, Bob Noel and Jacob Tilton. One team conducted alcohol washes, found drone cells, and marked evaluation frames in each colony: J. J. Tilton and Jim Amrine.**

**Results: about 25-75 dead young workers were found in front of each hive and up to 100 brood were found killed in some colonies and others with only a few. This is a sign of a successful treatment. Very large numbers of small hive beetles appeared on the screened sticky boards, especially on the down-wind bee hives; it was obvious that they had flown in that night and drifted toward the down-wind end of the colonies. Three colonies had old black drone comb (red asterisk) which allowed more mites to survive. Average mortality of VM in sealed Drone cells: 93.71%.**

Twenty hives treated with 50% formic acid, 110ml, +15ml HBH-LG, 3:30pm, 23 Oct, 2006.

Mite counts on 24 Oct, 2006, from 100 sealed drone cells per hive:

	Alive	Dead	Total Mites	%Mortality	#Cells Inf	Alcohol Post-trtmnt	Alcohol Pre-trtmnt	Post-trt Strength	Pretrtmnt Strength
FA11	0	39	39	100.00	13	2	15	9	9
FA12	0	67	67	100.00	36	6	9	8	8
FA13	* 31	57	88	64.77	27	15	17	5	7
FA14	0	74	74	100.00	30	11	12	8	8
FA15	3	23	26	88.46	21	18	19	7	6
FA16	0	21	21	100.00	15	4	9	7	6
FA17	1	33	34	97.06	12	4	16	6	7
FA18	* 10	51	61	83.61	32	7	13	6	6
FA19	1	9	10	90.00	9	9	7	7	7
FA20	1	30	31	96.77	22	8	15	7	7
FA21	* 16	33	49	67.35	36	3	5	6	8
FA22	0	23	23	100.00	17	32	20	7	7
FA23	1	11	12	91.67	10	8	1	7	7
FA24	0	51	51	100.00	14	18	53	7	8
FA25	0	32	32	100.00	9	6	10	7	8
FA26	2	53	55	96.36	24	1	12	7	8
FA27	0	43	43	100.00	29	12	7	8	8
FA28	0	61	61	100.00	28	10	9	7	6
FA29	0	47	47	100.00	12	3	3	7	6
FA30	1	52	53	98.11	26	1	4	7	7
total mit	67	810	877	92.36	422	178	256	7	7.2
				93.71	20.84	9.32	13.26	7.00	7.21

<b>FA11</b>	<b>100.00</b>
<b>FA12</b>	<b>100.00</b>
<b>FA13</b>	<b>64.70</b>
<b>FA14</b>	<b>100.00</b>
<b>FA15</b>	<b>88.46</b>
<b>FA16</b>	<b>100.00</b>
<b>FA17</b>	<b>97.06</b>
<b>FA18</b>	<b>83.61</b>
<b>FA19</b>	<b>90.00</b>
<b>FA20</b>	<b>96.77</b>
<b>FA21</b>	<b>67.35</b>
<b>FA22</b>	<b>100.00</b>
<b>FA23</b>	<b>91.67</b>
<b>FA24</b>	<b>100.00</b>
<b>FA25</b>	<b>100.00</b>
<b>FA26</b>	<b>96.36</b>
<b>FA27</b>	<b>100.00</b>
<b>FA28</b>	<b>100.00</b>
<b>FA29</b>	<b>100.00</b>
<b>FA30</b>	<b>98.11</b>

**Average Mortality of Varroa mites in Capped Drone Cells, 24 Oct 2006 = 93.7%**

<b>Mean</b>	<b>93.70</b>
<b>Standard Error</b>	<b>2.37</b>
<b>Median</b>	<b>99.06</b>
<b>Mode</b>	<b>100.00</b>
<b>Standard Deviation</b>	<b>10.58</b>
<b>Variance</b>	<b>111.92</b>
<b>Kurtosis</b>	<b>3.48</b>
<b>Skewness</b>	<b>-2.04</b>
<b>Range</b>	<b>35.30</b>
<b>Minimum</b>	<b>64.70</b>
<b>Maximum</b>	<b>100.00</b>
<b>Sum</b>	<b>1874.09</b>
<b>Count</b>	<b>20.00</b>
<b>Confidence Level(0</b>	<b>4.64</b>

**Average Mortality of Varroa Mites in capped drone cells after removing the 3 colonies with old black brood combs.**

<b>FA11</b>	<b>100.00</b>
<b>FA12</b>	<b>100.00</b>
<b>FA14</b>	<b>100.00</b>
<b>FA15</b>	<b>88.46</b>
<b>FA16</b>	<b>100.00</b>
<b>FA17</b>	<b>97.06</b>
<b>FA19</b>	<b>90.00</b>
<b>FA20</b>	<b>96.77</b>
<b>FA22</b>	<b>100.00</b>
<b>FA23</b>	<b>91.67</b>
<b>FA24</b>	<b>100.00</b>
<b>FA25</b>	<b>100.00</b>
<b>FA26</b>	<b>96.36</b>
<b>FA27</b>	<b>100.00</b>
<b>FA28</b>	<b>100.00</b>
<b>FA29</b>	<b>100.00</b>
<b>FA30</b>	<b>98.11</b>

<b>Mean</b>	<b>97.55</b>
<b>Standard Error</b>	<b>0.93</b>
<b>Median</b>	<b>100.00</b>
<b>Mode</b>	<b>100.00</b>
<b>Standard Deviation</b>	<b>3.85</b>
<b>Variance</b>	<b>14.80</b>
<b>Kurtosis</b>	<b>1.19</b>
<b>Skewness</b>	<b>-1.55</b>
<b>Range</b>	<b>11.54</b>
<b>Minimum</b>	<b>88.46</b>
<b>Maximum</b>	<b>100.00</b>
<b>Sum</b>	<b>1658.43</b>
<b>Count</b>	<b>17.00</b>
<b>Confidence Level(0</b>	<b>1.83</b>

## Mortality in Control Hives, 24 Oct 2006.

<b>C11</b>	<b>0.00</b>
<b>C12</b>	<b>1.75</b>
<b>C13</b>	<b>15.91</b>
<b>C14</b>	<b>0.00</b>
<b>C15</b>	<b>0.00</b>
<b>C16</b>	<b>0.00</b>
<b>C17</b>	<b>2.86</b>
<b>C18</b>	<b>0.00</b>
<b>C19</b>	<b>0.00</b>
<b>C20</b>	<b>2.30</b>

<b>Mean</b>	<b>2.28</b>
<b>Standard Error</b>	<b>1.55</b>
<b>Median</b>	<b>0.00</b>
<b>Mode</b>	<b>0.00</b>
<b>Standard Deviation</b>	<b>4.92</b>
<b>Variance</b>	<b>24.18</b>
<b>Kurtosis</b>	<b>8.60</b>
<b>Skewness</b>	<b>2.87</b>
<b>Range</b>	<b>15.91</b>
<b>Minimum</b>	<b>0.00</b>
<b>Maximum</b>	<b>15.91</b>
<b>Sum</b>	<b>22.82</b>
<b>Count</b>	<b>10.00</b>
<b>Confidence Level(0</b>	<b>3.05</b>

**Mortality in Control Hives, 24 Oct 2006,  
less C13 (it had 7 dead varroa mites).**

<b>Control less C13; 7 dead n</b>	
<b>C11</b>	<b>0.00</b>
<b>C12</b>	<b>1.75</b>
<b>C14</b>	<b>0.00</b>
<b>C15</b>	<b>0.00</b>
<b>C16</b>	<b>0.00</b>
<b>C17</b>	<b>2.86</b>
<b>C18</b>	<b>0.00</b>
<b>C19</b>	<b>0.00</b>
<b>C20</b>	<b>2.30</b>

<b>Mean</b>	<b>0.77</b>
<b>Standard Error</b>	<b>0.39</b>
<b>Median</b>	<b>0.00</b>
<b>Mode</b>	<b>0.00</b>
<b>Standard Deviation</b>	<b>1.18</b>
<b>Variance</b>	<b>1.40</b>
<b>Kurtosis</b>	<b>-0.81</b>
<b>Skewness</b>	<b>1.06</b>
<b>Range</b>	<b>2.86</b>
<b>Minimum</b>	<b>0.00</b>
<b>Maximum</b>	<b>2.86</b>
<b>Sum</b>	<b>6.91</b>
<b>Count</b>	<b>9.00</b>
<b>Confidence Level(0</b>	<b>0.77</b>

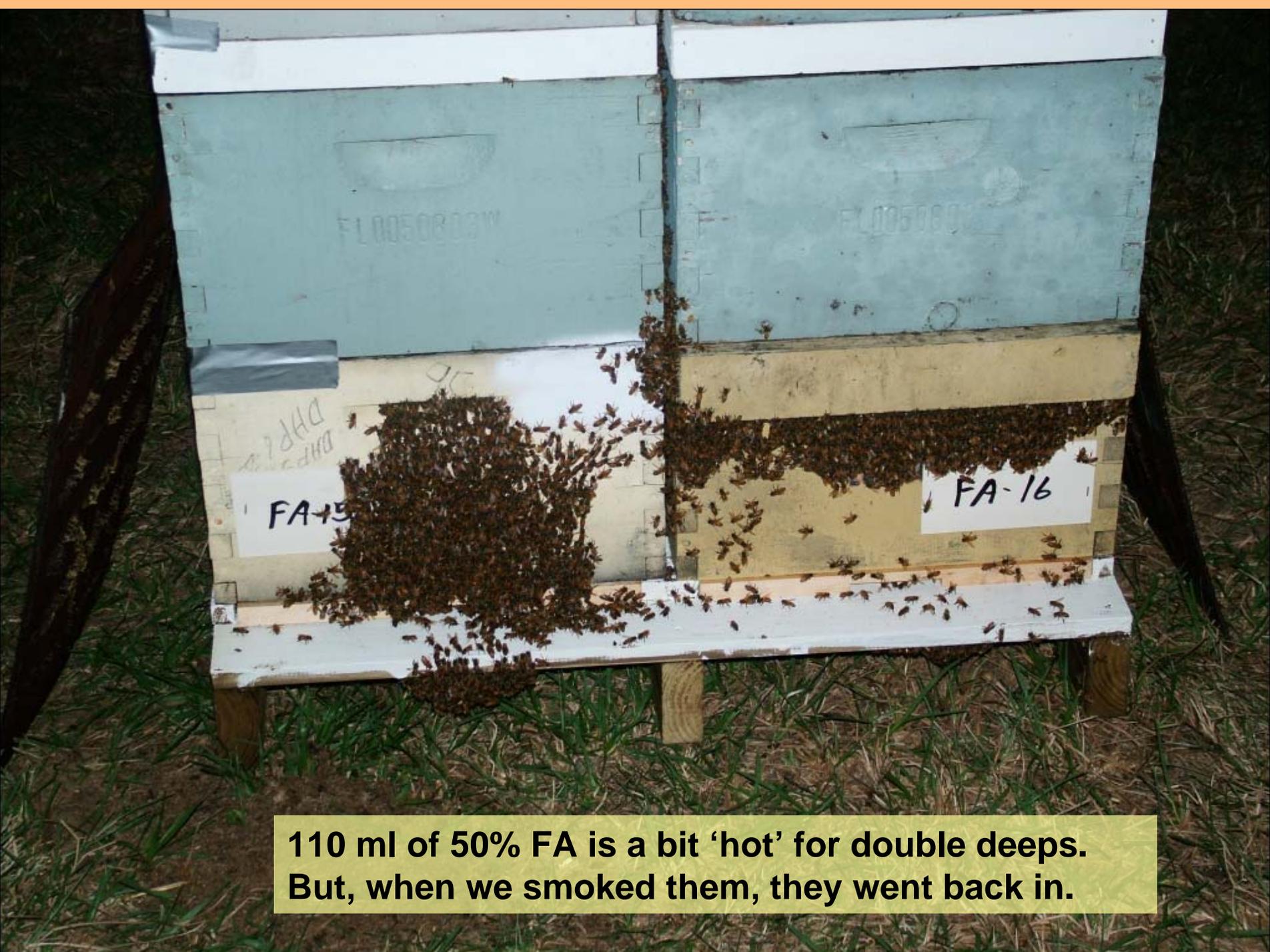
**Mites on Adult bees removed by Alcohol wash, post-treatment:**

**We believe that varroa mites, concealed between abdominal sternites, died in place during the fumigation. Shaking bees in alcohol pulls the dead mites out. We need to verify this hypothesis by collecting an equal sample of bees and going through them one by one to see if the mites are alive or dead. A powdered sugar treatment would remove live mites still walking about on the bees. Then, an alcohol wash would remove dead bees from under the sternites.**

	Alcohol Pre-trtmnt	Alcohol Post-trtmnt	Strength Pre-trtmnt	Strength Post-trtmnt
FA11	15	2	9	9
FA12	9	6	8	8
FA13	17	15	7	5
FA14	12	11	8	8
FA15	19	18	6	7
FA16	9	4	6	7
FA17	16	4	7	6
FA18	13	7	6	6
FA19	7	9	7	7
FA20	15	8	7	7
FA21	5	3	8	6
FA22	20	32	7	7
FA23	1	8	7	7
FA24	53	18	8	7
FA25	10	6	8	7
FA26	12	1	8	7
FA27	7	12	8	8
FA28	9	10	6	7
FA29	3	3	6	7
FA30	4	1	7	7
Sum	256	178	144	140
Avg	12.80	8.90	7.20	7.00

**Preparing 20 colonies for 50% Formic Acid Fumigation.**



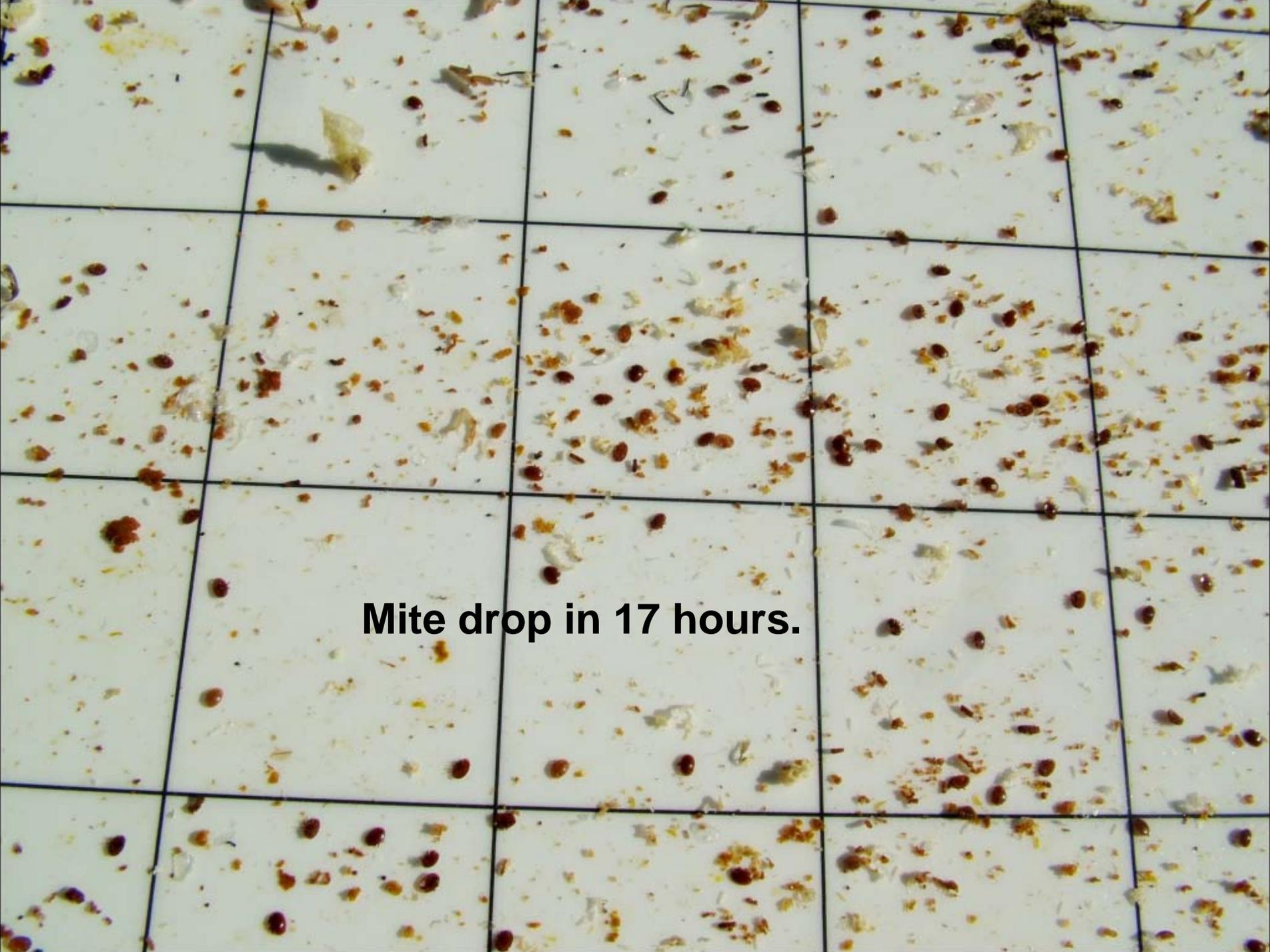


**110 ml of 50% FA is a bit 'hot' for double deeps. But, when we smoked them, they went back in.**

**Work bench set up by Jerry and Mary Turner. From left, Mary Turner, Jerry Turner, Bob Noel, Jacob Tilton and J. J. Tilton.**





A photograph of a white grid with 4 rows and 4 columns of squares. Each square contains numerous small, reddish-brown droppings, likely from mites. The droppings are scattered across the grid, with some appearing as small, round beads and others as irregular, fragmented pieces. The overall appearance is that of a dense collection of mite excrement.

**Mite drop in 17 hours.**



**Old black comb; many mites were sheltered by these thicker cappings and sidewalls.**



**Hive FA11: Bob said all mites found in these light drone combs would be dead. He was right; 39 found, 39 dead.**

Looking south at the crew finishing the control hives; 5:30 pm, 23 October, 2006.





**Very large numbers of small hive beetles were found on 24 October in several colonies at the lee end (south end) of the pallets of bees treated by Formic Acid. These numbers were not seen on the 23<sup>rd</sup> when hives were broken down and the fumigators were applied. Nor were they seen on the control hives, either day.**

**Hypothesis: hive beetles flew into the colonies from the surrounding area, during and just after the treatment, and the wind caused them to drift to the lee end of the palletted bees.**

**Researchers say that disturbances of the hives cause stress in the bees, which then release alarm pheromones and that the beetles home in on the alarm pheromones.**

**However, our control colonies had very few hive beetles compared to the formic acid treated colonies. The same number of frames were examined and 100 brood cells opened in each hive, so the stress should have been very similar.**

**Summary: In 2006, we treated 31 colonies with the 50% formic acid fumigator and Honey-B-Healthy in Florida. The resultant mite mortality in capped drone cells was:**

- 1) 99.2% on 3 April (84° F, ~50% RH, 9:15am) (85ml 50% FA + 15 ml HBH; 2-deep, a single hive demonstration; 200 cells were opened); DPI “Church Bee Yard”, Alachua Co., FL.**
- 2) 92.6% on 15 August (T 94° F, 58,7% RH; 1:30pm) (90ml 50% FA +15 ml HBH; 10, 2-deep colonies (100 cells per colony)) (Mr. Hope’s property, Cocoa, FL), and**
- 3) 93.7% on 23 October (T 81.8° F, RH 41.2%; 5pm) (110 ml 50% FA + 15 ml HBH, 5PM; 20, 2-deep colonies (100 cells per colony)) (Duda Ranch, Melbourne, FL).**

**Will the honey bee become...**

**... EXTINCT?**

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