

The 50% Formic Acid Paper Pad Treatment for Varroa

**Developed by Bob Noel and Jim Amrine,
in FL, WV & MD in 2007-2008.**

Source of the paper pads that gave us excellent results:

Papers are specially designed to release air freshener oils.

Quote from Deborah Fenske, 15 June 2007. **Gusmer Enterprises,**
Inside Sales Representative - Specialty Products

1401 Ware Street, Waupaca, WI

dfenske@gusmerenterprises.com

Telephone: 715-258-5525, ext. 144

Material: AC-16

Thickness: 0.100"

Size: 8-1/4" x 11"

Quantity and Price per 1000, FOB Waupaca, WI

1,000 = \$480.75/M (\$.48 each)

2,500 = \$460.75/M (\$.46 each)

5,000 = \$445.75/M (\$.45 each)

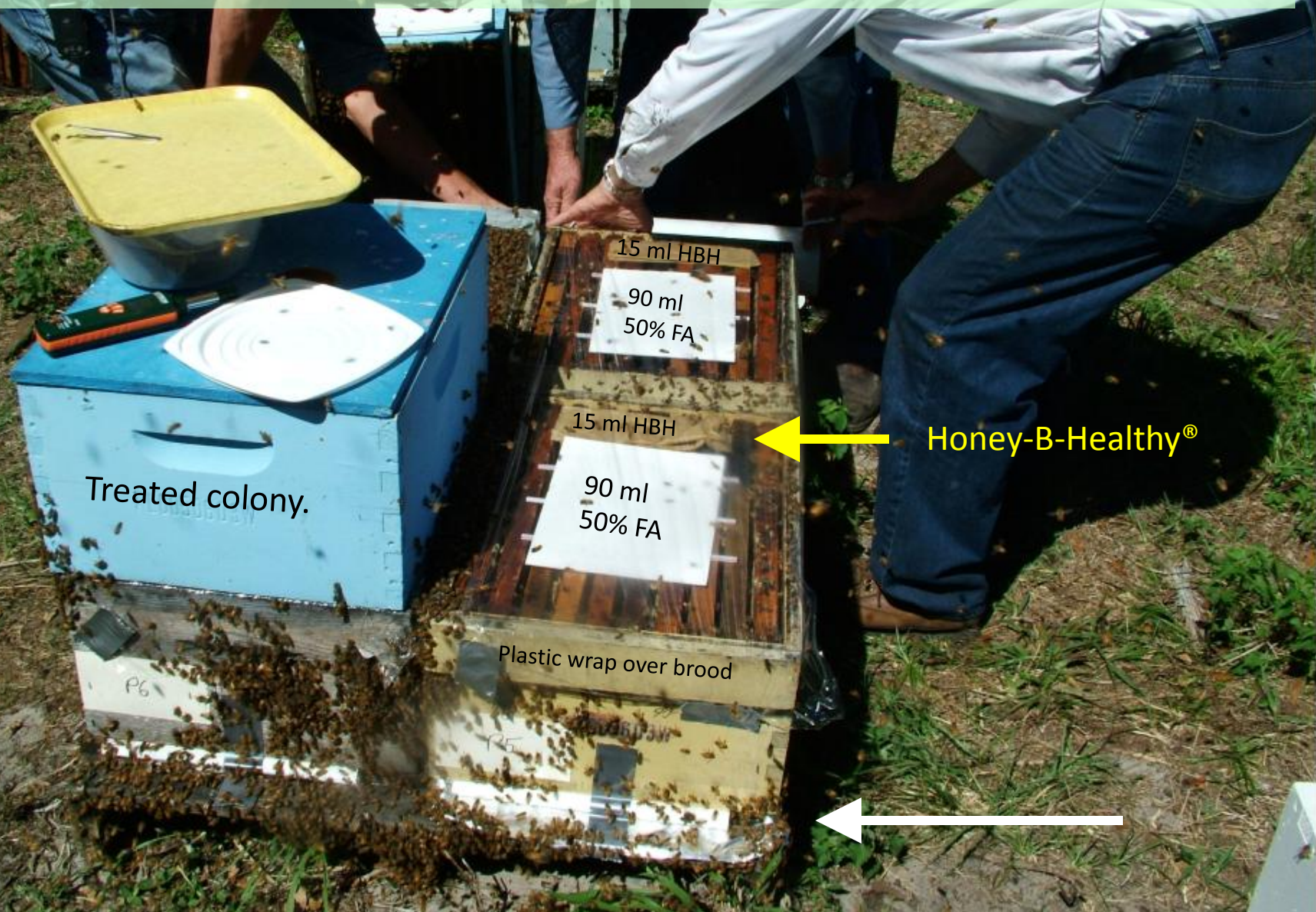
10,000 = \$440.75/M (\$.44 each)

Delivery: "We can ship 2-3 weeks after receipt of purchase order."

Terms: Net 30 Days pending credit approval.

This quotation is firm until December 13, 2007.

New Paper-Pads: treating 2 colonies at once: 50% formic acid on paper pads; HBH on paper towels to protect queens, covered w plastic wrap.



Ft. Pierce, FL: 16Apr07. Entrance reduced with paper and duct tape.



Treated Colony - 1 ½ story - (75ml formic on pad + 15ml Honey-B-Healthy on paper towel)

- Wood-Framed Queen Excluder above freezer paper allows more air circulation around the pad.

-Taped Freezer Paper covers the FA pad. (white arrow).

-It takes about 5 minutes to put on a treatment; bees can remove all items but the wood entrance reducer, which can be replaced by paper held in place with duct tape.

-3/8" x 3.5" reduced centre opening in entrance reducer. Or use paper leaving: ¾" 1.5".

-- Seal or replace screened bottom board; seal any openings or holes.



We use about seven 'Gummy Candies' placed on top bars of brood frames to hold and adjust the paper pad above the brood. Candies will compress. Bees will remove pad, towel, candy and freezer paper and paper entrance.

**Measuring 50%
formic acid with a
hydrometer. Specific
gravity is 1.110**



**Verifying 50% Formic Acid:
Specific Gravity = 1.110.**



\$8.90 at

[http://www.williamsbrewing.com/BREWERS EDGE HYDROMETER P527.cfm](http://www.williamsbrewing.com/BREWERS%20EDGE%20HYDROMETER%20P527.cfm) (13 Feb 09)



Place 85ml of 50% Formic Acid in a graduated measuring glass.

We used: - 85ml 50% FA - for two full depth brood boxes.

- 75ml 50% FA - for 1 and 1/2 depth brood boxes.

- 60ml 50% FA - for single full depth brood boxes.

Note: These recommended doses are lower than our first trials. Beekeepers need to carefully observe the results of each set of treatments.



15ml of HBH is added to a paper towel and placed on the top bars near the 85ml 50% formic on double brood chambers; HBH helps to prevent queen loss.



Sides w
3/8"
beeways

Freezer paper - 13.5" x 21" [34.3cm x 53.3cm] - with shiny side up, with duct tape in front and back to keep it in place. Leave 3/8" beeways on each side: vapors go into upper supers and kill all varroa mites on adult bees; it does not taint the honey. Waxed paper can be used in place of freezer paper.



Treated Colony. Note the entrance reduced to 3/8" x 3.5" [.95cm x 8.9cm] at the centre. The chamber with most brood was placed under the treated pad. Paper and duct tape can be used to reduce the front entrance to 1.75" x .75" [4.4cm x 1.9cm].

**Dead mites – fell from upper supers
after 23 hrs.**

Tunisia, 11am, 23 Oct 2007

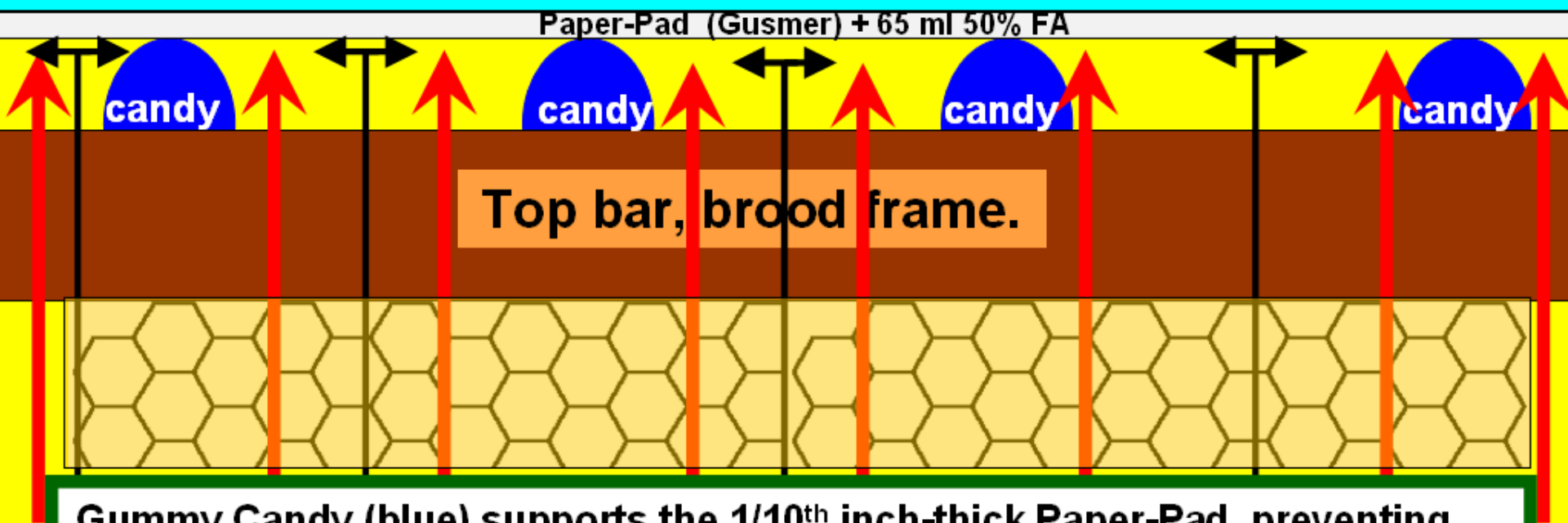
(*Apis mellifera intermissa*

Jim Amrine; workshop for IJA).



How & why the Paper-Pad method works:

Freezer Paper (blue-green for this diagram), shiny side up.



Gummy Candy (blue) supports the 1/10th inch-thick Paper-Pad, preventing liquid FA from bleeding onto brood cells and bees.

Heat from the brood (**red arrows**) is trapped under the Paper-Pad by the freezer paper.

Bees fan up between the frames (black arrows) and around the gummy candy to evaporate the 50% formic acid; it is gone in less than 24 hours.

Everything will be removed by the bees in a few days; no return trip needed.



Dry pad - removed 18 hours later. No odor of formic acid (MD,18Aug 07). Weak colonies and treatments in January or during heavy brood production in March or April do not achieve these results.



**Video of treatment results, 4 October, 2007, at Cumberland, Maryland;
Harry Mallow's bees.**



Fort Pierce, FL, 16Apr07, 4:41:14 pm, colony P6: RH = 71.9%, T = 96.0
F. Bees fan vigorously, increasing the temperature to about 97_ F. FA
vapor exits the reduced entrance. About 55 mins after treatment; this
was 2nd highest T recorded (97.3 F was max).

A piece of paper can be used to reduce the entrance to a 7/4 x 1.5" [1.5 cm X 2 cm] central opening; bees remove it in a few days.



Dead varroa mites at the entrance and on assayed drone brood (inset).



A handful of dead, emerging workers below the entrance is the sign of a good treatment. If it kills a few of them, it will kill 93% or more of the varroa mites.



Why does 50% FA kill mites and young workers and some brood, but not the rest of the bees?

Mature honey bees (both mature larvae and mature adults) have an outer cement layer on their cuticle that repels/resists harmful chemicals. It takes emerging workers/drones 24 to 48 hours to develop this final cement layer, thus these are killed. If you see or anticipate large numbers of emerging brood, postpone your treatment for a few days.

Varroa mites lack a protective cement layer on their cuticle and will always be susceptible to FA.



Ideal Assay: open 100 capped drone cells per hive; count dead mites.



Honey cappings, closeup: made of pure beeswax: it is relatively impervious to water vapor and FA.



**Larvae & Pupae
must be able to
breathe.**

Drone and Worker Cappings: made from wax + wood & plant fibers + pollen and part of cell walls - all are put into the cappings so that gasses can enter and leave.

After a few days the bees remove the Gusmer Paper Pads from the hive. Freezer paper and paper inserts at the entrance are also removed by the bees.

However, Paper-Pads can be reused many times, if it is economical to do so. Pads cost about \$.48 each.





This queen at Rick's bee yard had 3 formic acid treatments in 7 months; she survived them all, thanks to HBH! Two tests were done during very hot weather in July/August 2006 to see if the bees and queens would survive - in preparation for August treatments in Florida.

Results of 23 paper pad tests since March, 2007; assay of capped brood.

All Paper-Pad Treatments, 2007										
	Number	Number	Total		# Cells	# Cells				
<u>HIVES</u>	<u>Alive</u>	<u>Dead</u>	<u>Mites</u>	<u>%Mortality</u>	<u>Infested</u>	<u>Examned</u>	<u>%infested</u>	<u>Notes</u>	<u>ml</u>	<u>Date</u>
Pad1	3	52	55	94.55	26	118	22.03	Drones	95	29Mar07
FL1	0	33	33	100.00	20	100	20.00	Drones	90	17Apr07
FL2	8	60	68	88.24	38	100	38.00	Drones	90	17Apr07
FL3	0	33	33	100.00	20	100	20.00	Drones	90	17Apr07
FL4	0	31	31	100.00	10	100	10.00	Drones	90	17Apr07
FL5	2	24	26	92.31	11	100	11.00	Drones	90	17Apr07
FL6	1	55	56	98.21	26	100	26.00	Drones	90	17Apr07
FL7	8	74	82	90.24	38	100	38.00	Drones	90	17Apr07
FL8	1	17	18	94.44	15	100	15.00	Drones	90	17Apr07
JUDY1	11	58	69	84.06	38	60	63.33	QE; drone	85	10Sep07
JUDY2	0	48	48	100.00	35	79	44.30	QE; drone	85	10Sep07
JUDY3	0	61	61	100.00	35	61	57.38	QE; drone	85	10Sep07
ROB1	0	15	15	100.00	9	21	42.86	QE; drone	75	17Sep07
ROB2	0	31	31	100.00	20	53	37.74	QE; drone	80	17Sep07
ROB3	1	57	58	98.28	32	50	64.00	QE; drone	75	17Sep07
ROB4	0	29	29	100.00	16	54	29.63	QE; drone	75	17Sep07
ROB5	0	51	51	100.00	32	54	59.26	QE; drone	80	17Sep07
5fr-Nuke	7	73	80	91.25	42	96	43.75	Workers	37	01Oct07
3fr-Nuke	0	34	34	100.00	19	101	18.81	Workers	28	06Oct07
Cumb-1	2	94	96	97.92	51	100	51.00	QE-Worker	65	9Oct07
Cumb-2	5	137	142	96.48	66	100	66.00	QE-Worker	65	9Oct07
Cumb-3	0	40	40	100.00	20	100	20.00	QE-Worker	65	9Oct07
Cumb-4	0	64	64	100.00	38	100	38.00	QE-Worker	65	9Oct07
Cumb-5	0	103	103	100.00	56	100	56.00	QE-Worker	65	9Oct07
SUM/MEA	49	1274	1323	96.30	30	85	37.17			
	Average %Mortality			96.92	N = 24					
	Overall%Mortality			96.30						

Average mortality was 96.92%; the overall average mortality (1274 dead /1323 total) = 96.30%.

All Control Hives, 2006-2007.					Number	Number		
HIVES	Alive	Dead	Mites	%Mortality	Infested	Examined	%infested	Date
Aug C1	180	0	180	0.00	54	100	54.00	Aug06
Aug C2	116	3	119	2.52	42	100	42.00	Aug06
Aug C3	156	0	156	0.00	66	100	66.00	Aug06
Aug C4	24	0	24	0.00	24	100	24.00	Aug06
Aug C5	22	0	22	0.00	8	100	8.00	Aug06
Aug C6	6	0	6	0.00	4	100	4.00	Aug06
Aug C7	14	0	14	0.00	5	100	5.00	Aug06
Aug C8	23	0	23	0.00	20	100	20.00	Aug06
Aug C9	44	1	45	2.22	12	100	12.00	Aug06
Aug C10	7	1	8	12.50	7	100	7.00	Aug06
Oct C1	87	0	87	0.00	52	100	52.00	Oct06
Oct C2	56	1	57	1.75	34	100	34.00	Oct06
Oct C3	37	7	44	15.91	28	100	28.00	Oct06
Oct C4	38	0	38	0.00	13	100	13.00	Oct06
Oct C5	15	0	15	0.00	13	100	13.00	Oct06
Oct C6	27	0	27	0.00	20	100	20.00	Oct06
Oct C7	34	1	35	2.86	18	100	18.00	Oct06
Oct C8	17	0	17	0.00	9	100	9.00	Oct06
Oct C9	5	0	5	0.00	5	100	5.00	Oct06
Oct C10	85	2	87	2.30	29	100	29.00	Oct06
Jan C1	5	0	5	0.00	5	100	5.00	Jan07
Jan C2	14	1	15	6.67	15	100	15.00	Jan07
Jan C3	8	0	8	0.00	6	100	6.00	Jan07
Jan C4	6	0	6	0.00	4	100	4.00	Jan07
Jan C5	1	0	1	0.00	1	100	1.00	Jan07
Jan C6	3	1	4	25.00	3	100	3.00	Jan07
Jan C7	17	0	17	0.00	9	100	9.00	Jan07
Jan C8	1	0	1	0.00	1	100	1.00	Jan07
Jan C9	7	0	7	0.00	5	100	5.00	Jan07
Jan C10	4	0	4	0.00	4	100	4.00	Jan07
Apr07-1	29	1	30	3.33	18	100	18.00	Apr07
Apr07-2	39	1	40	2.50	22	100	22.00	Apr07
Apr07-3	1	0	1	0.00	1	100	1.00	Apr07
5fr-Nuk	74	2	76	2.63	31	105	29.52	1Oct07
3fr-Nuk	36	2	38	5.26	25	107	23.36	6Oct07
Cumb-1	94	0	94	0.00	62	100	62.00	8Oct07
Cumb-2	38	0	38	0.00	37	100	37.00	8Oct07
Cumb-3	9	0	9	0.00	13	100	13.00	8Oct07
Cumb-4	35	0	35	0.00	31	100	31.00	8Oct07
Cumb-5	67	1	68	1.47	49	100	49.00	8Oct07
SUM/MEA	1481	25	1506	1.66	20	100	20.05	
	Average % Mortality			2.17	N = 40			
	Overall % Mortality			1.66				

Control hives, 2006-2007.

Average control mortality was 2.17%; this value was skewed upward by several low counts with one or two dead mites.

The overall control mortality was 1.66% based on 25 dead mites out of 1,506 total.

Statiscal Analysis was conducted by Dr. Yong-Lak Park, Entomologist, WVU.

Anova for all data

Hypothesis: there is no difference in mortality between paper-pad treatment and control

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Paper pad	23	2225.97	96.78132	21.30506
No paper pad	34	80.19428	2.358655	28.53784

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>
Treatment	122316.3	1	122316.3	4769.648	P < 0.001
Error	1410.46	55	25.64473		
Total	123726.8	56			

Result: there is a highly significant difference in mortality between paper-pad treatment and control

Why Does 50% Formic Acid Paper-Pad Fumigation work better than other formic acid applications?

Using 50% Formic Acid in an absorbent pad above the brood nest, a 'true vapor' is formed that hangs in the hive and penetrates the brood cappings, killing the varroa mites inside. Only a few hours of 50% FA vapor is needed to fumigate the capped cells.

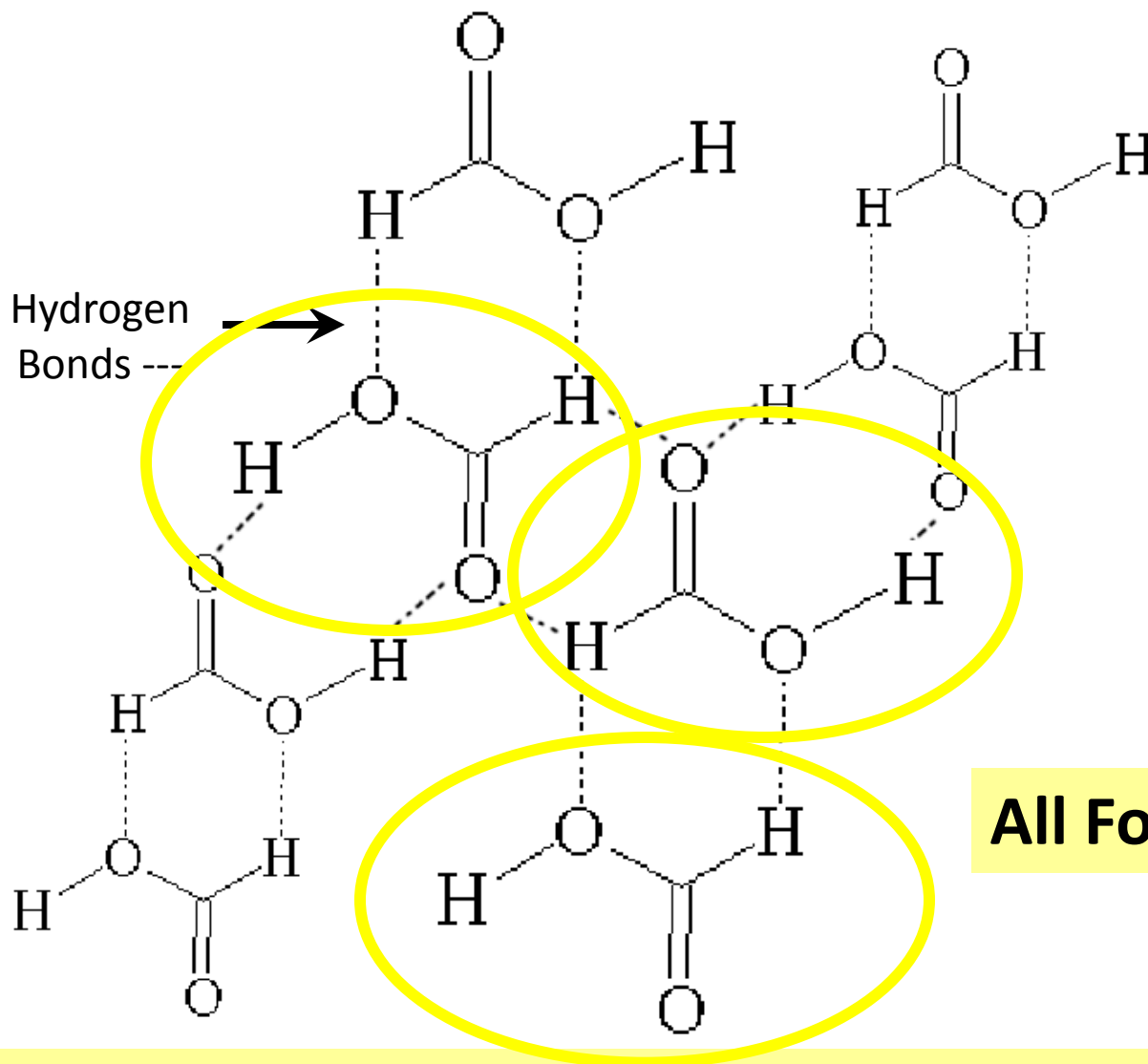
Slow release of formic acid, 80%, 65%, or even 50%, never develops the correct vapor cloud that will penetrate the cappings and kill the mites

At higher concentrations, strong hydrogen bonding between formic acid molecules produces a cohesive, heavy 'vapor' that acts more like a fluid; it flows down to the bottom board and out onto the grass, often killing the grass. The entrance must be reduced to hold in the 50% vapor; but, most other methods keep the entrance wide open.

At a ratio of 1:1 water to FA (50%), the hydrogen bonding effect is much less and the FA dissipates evenly, forming a true vapor, penetrating the cappings and killing the varroa mites (and tracheal mites).

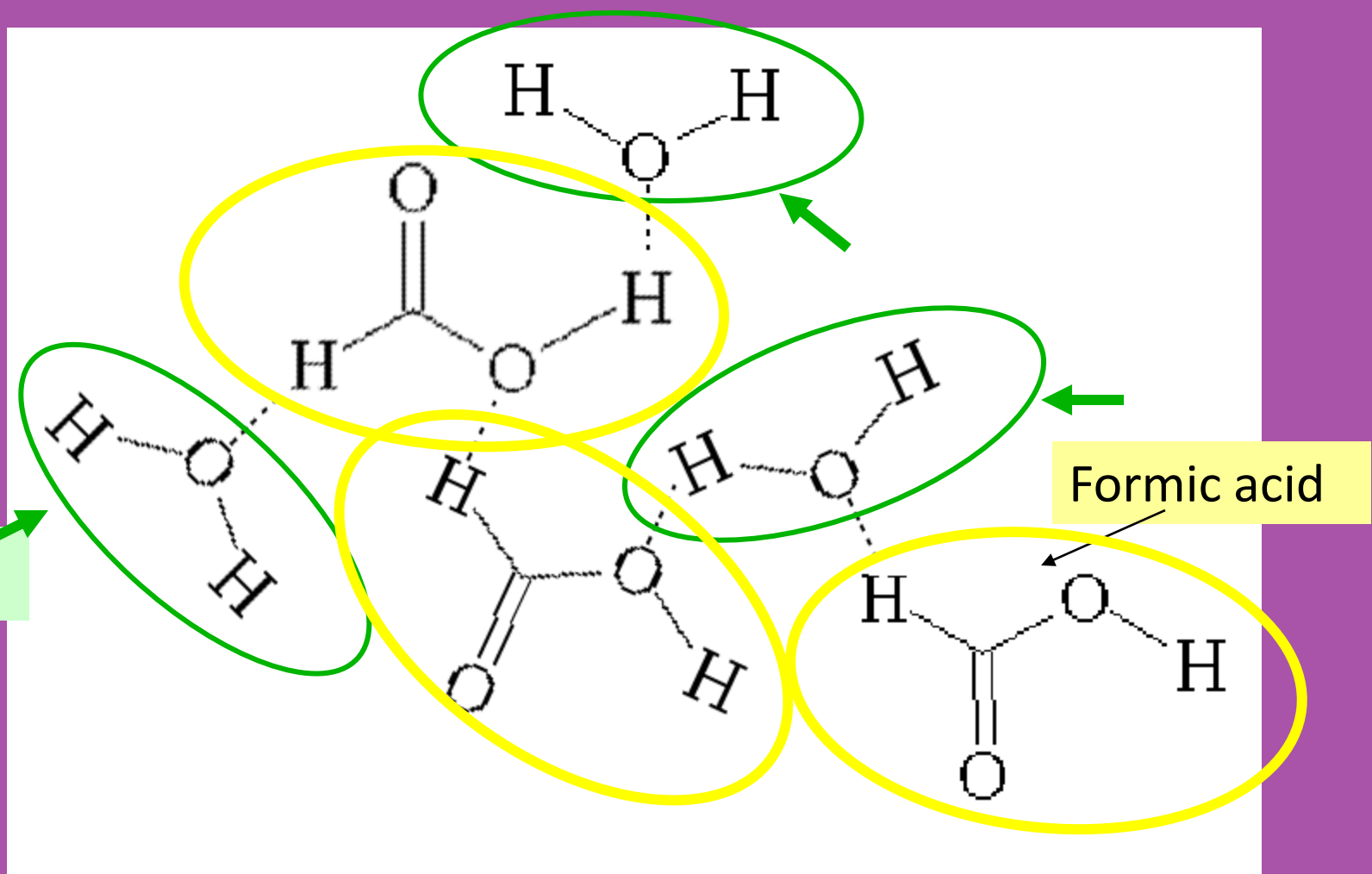
About 85ml of 50% FA, - present as a vapor cloud for just 16-24 hours - penetrates the cappings and kills vm in capped brood cells and dissipates by the next day.

However old, black brood cappings protect varroa.



All Formic acid

100% formic acid, anhydrous: a huge series of hydrogen bonds; Because of this, 'vapors' of 65% and 80% solutions act more like fluids than gases; they sink to the bottom board. Specific gravity of this moiety approaches 1.22



In 50% Formic Acid there is one water molecule for each formic molecule. Specific Gravity = 1.110.

On evaporation, this Acid becomes a true vapor, not a fluid, and penetrates the brood cappings.

October, 2006, Cocoa, Florida. Preparing 20 colonies for 50% Formic Acid Fumigation and 10 colonies for control [water + HBH].





Video: Assay

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