

**Controlling The Pests of Honey Bees,
50% Formic Acid Fumigation for Controlling Varroa Mites In Florida, 2006.
Report of Research, 2006.**

In 2006, we worked with several beekeepers in FL to save declining Honey Bee Colonies by feeding Honey-B-Healthy® (HBH), a feeding supplement containing Spearmint and Lemongrass essential oils, added to sugar syrup at 10 ml of HBH per 0.9 L of syrup. Colonies were also treated with a grease patty mix containing hydrogenated vegetable oil, granulated sugar, salt, honey, and wintergreen oil (ca 200g patty mix on brood frames per 3 weeks) (Amrine et al. 2006, Noel 2006). As a result of feeding HBH and grease patties, bees showed considerably improved health, foragers lived longer, honey crops improved and parasitic mites and pathogens declined in colonies.

Selected colonies were not given these treatments in order to allow Varroa mites to reach injurious levels (more than 20 mite-infested, capped drone cells per 100 inspected), so that we could employ the specially engineered 50% formic acid fumigator to control the mites (Amrine et al., 2006).

Three applications of the 50% formic acid fumigator were made in 2006: 3 April 2006 (a single hive, pre-proposal demonstration), 15 August 2006 on 10 treated hives and 10 control hives during hot weather (94° F and 58% RH), in conditions that were presumed marginal for treatments due to the hot weather, and on 23 October, 2006, on 20 colonies (and 10 controls), under more suitable treatment conditions. We are now preparing to treat 20 single hives at Melbourne, Florida, on 2 January 2007.

On 3 April, 2006, the fumigator was applied at 9:15 am, using 90 ml of 50% Formic Acid and 15 ml of Honey-B-Healthy (Spearmint-Lemongrass essential oils to prevent queen loss). The fumigator was removed at 8:33 am on 4 April, 2006 (23 hours, 18 minutes). 200 mostly drone and some worker 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 for a total of 237 dead mites and 235 live mites, and 99.2% overall mortality of varroa mites in this treatment. The mortality in capped drone cells was 168/170 or 98.82%. The queen was not lost (Westervelt, personal communication, 24 Apr 2006).

On 15 August, 2006, at the Hope Ranch, just west of Cocoa, Florida, ten colonies were treated with 90ml of 50% formic acid mixed with 15 ml of HBH, starting at 13:30. The temperature was 94° F, relative humidity was 58%, partly cloudy with an intermittent east wind at 0-10 mph. Fumigators were removed the next day starting at 10:30 am and mite numbers and mortality were recorded from 100 capped drone cells per colony (Table 1).

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 mites	494	94.73684	588.7368	Range: 72.1 to 100%		
		Average Mortality		92.59		IN CAPPED DRONE CELLS.

The average mortality of varroa mites in capped drone cells for 10 controls was 1.72%. Low numbers of mites in 3 colonies skewed this data; the overall mortality was 0.83%. N=20.

Proportion mortality data were arcsine square-root transformed before analysis (Fry 1993) with ANOVA (SAS Institute 1999). Untransformed data are reported in figures:

Source	DF	SS	MS	F	Pr>F
Model	1	6.899	6.899	70.11	<0.001
Error	18	1.771	0.984		
Corrected Total	19	8.671			
R-Square 0.795; Coeff Var. 47.9488; Root MSE 0.313; mort Mean 0.6542					
Source	DF	Type I SS	MS	F	Pr>F
Model	1	6.899	6.899	70.11	<0.001
Source	DF	Type III SS	MS	F	Pr>F
treatment	1	6.899	6.899	70.11	<0.001

On 23 Oct, 2006, at the Duda Ranch, just west of Melbourne, Florida, twenty colonies were treated with 110ml of 50% formic acid mixed with 15 ml of HBH, starting at 17:00. The temperature was 60° F, relative humidity was 32%, clear with a steady north wind at 10-20 mph (cold front passed that day). Fumigators were removed the next day starting at 10:00 am and mite numbers and mortality were recorded from 100 capped drone cells per colony (Table 2).

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					Alcohol		Post-trt	
	Alive	Dead	Total Mites	%Mortality	#Cells Inf	Post-trtmnt	Pre-trtmnt	Strength	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

The average mortality of varroa mites in capped drone cells for 10 controls was 0.77%. The unusual high mortality of mites in colony 13 (15.91%) was probably due to residual pesticides and was removed from the data set.

We noticed that there was a great influx of adult bees from collapsing colonies, causing our alcohol washes to have unusually high numbers of varroa mites despite high mortality in brood cells. We believe that the passing cold front stimulated workers and drones from weak and collapsing colonies in the region to seek queenright colonies.

Again, proportion mortality data were arcsine square-root transformed before analysis (Fry 1993) with ANOVA (SAS Institute 1999). Untransformed data are reported in figures: N = 29.

Source	DF	SS	MS	F	Pr>F
Model	1	11.396	11.396	351.07	<0.0001
Error	27	0.8764	0.03246		
Corrected Total	28	12.272			

R-Square 0.928; Coeff Var. 18.2908; Root MSE 0.1801; mort Mean 0.9850

Source	DF	Type I SS	MS	F	Pr>F
Model	1	11.395	11.395	351.07	<0.0001

Source	DF	Type III SS	MS	F	Pr>F
treatment	1	11.395	11.395	351.07	<0.0001

These results show excellent control of varroa mites in the colonies.

Participating in the research were Jerry, Mary and Gary Turner, J.J. and Jacob Tilton, John Gentzel, Dimitry Albertese, Alberto Santini, Malcolm Brinson, and Gary Ranker. There are many commercial and hobbyist beekeepers in Florida using all or parts of our protocol to keep their colonies healthy.

References:

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