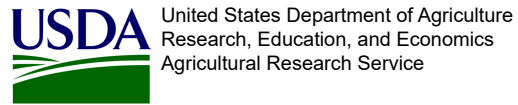


National Honey Bee Survey USDA/APHIS  
Honey Bee Wax/Pesticide Diagnostic Report

KEITH MALONE  
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Report Date: 09/20/2019  
Sample ID: AK-05-2018  
AMS Sample Number: AK-05-2018  
Date sample was collected: July 16, 2018  
Description:  
Sample Type: Wax

This report contains a summary of the pesticides and levels found in Wax sampled from your apiary as part of the USDA Animal and Plant Health Inspection Service (APHIS) funded National Honey Bee Pest and Disease Survey. Samples were analyzed by the USDA Agriculture Marketing Service (AMS) and results were summarized and are presented here by the USDA Agriculture Research Service (ARS) and the University of Maryland.

2017 is the first year of the National Survey in which pesticide residues in comb were analyzed rather than bee bread. In a recent study\* researchers found that pesticide contaminants in comb wax are more predictive of colony health than residues in pollen. In particular, higher number of products in wax were associated with higher colony mortality, and some classes of fungicides residues were found more frequently in wax of colonies that died versus those that survived the winter. Understanding and quantifying pesticide exposure in colonies is difficult and expensive. We decided to change our sampling protocol to maximize the potential value these results have in helping explain bee health.

Table 1 lists the pesticides that were detected in your Wax samples and provides a comparison to national averages. If no pesticides were found in your Wax, there will be no Table 1 in this report. Chart 1 provides a visual representation of the data given in Table 1.

Chart 2 illustrates the categories of pesticides detected from Wax taken for the National Survey since 2011. Pesticides can be classified in many ways, depending on what they act on or how they are chemically composed or made. This chart was created with beekeepers in mind, displaying those categories that may be of interest to those who treat with varroacides and those who may be near agricultural chemical applications. This chart just provides categorical information and does not provide any weighted value if some pesticides were at lethal doses.

Chart 3 is a histogram of all the pesticide data collected thus far. A histogram is a graph that shows the distribution of data. For example, 0 samples had no pesticides detected (0.0% of all samples) and at least one sample had as many as 38 pesticides detected.

Table 2 lists the level of detection (LOD) and the prevalence (percentage that the pesticide occurred) in all samples taken across the country as part of Wax sampling since 2017. For example, if the prevalence value for a pesticide is given as "10", the pesticide was detected in 10% of all samples received. Finally, this table also provides the average and the range in ppb (parts per billion) of pesticides found in all of the samples.

Table 3 is given as a separate appendix and lists the specific pesticides detected since 2017 . This table is an identification guide to help you identify what type of pesticide was detected, if any, and how the pesticide is typically used.

Also enclosed is the report generated at AMS regarding your specific sample. Please note, this report lists ALL pesticides that were tested for and most will be marked as "N.D." = not detected. The ones that were detected in your sample are highlighted in yellow.

**Table 1: Pesticides found in samples from your hives**

Pesticide Detected <sup>1</sup>	LOD (ppb) <sup>2</sup>	Level Detected in your Colonies (ppb) <sup>3</sup>	National Average (ppb) <sup>4</sup>	National Prevalence (%) <sup>5</sup>
DEET	13.0	18	136.9	31.4
Dicloran	25.0	Trace	26.0	2.4
Fenpyroximate	3.0	Trace	76.5	48.2
Fluvalinate	50.0	Trace	896.6	74.1
Piperonyl Butoxide	6.0	Trace	59.2	67.9
Propargite	5.0	6	56.9	43.2

<sup>1</sup>Name of the pesticide(s) detected.

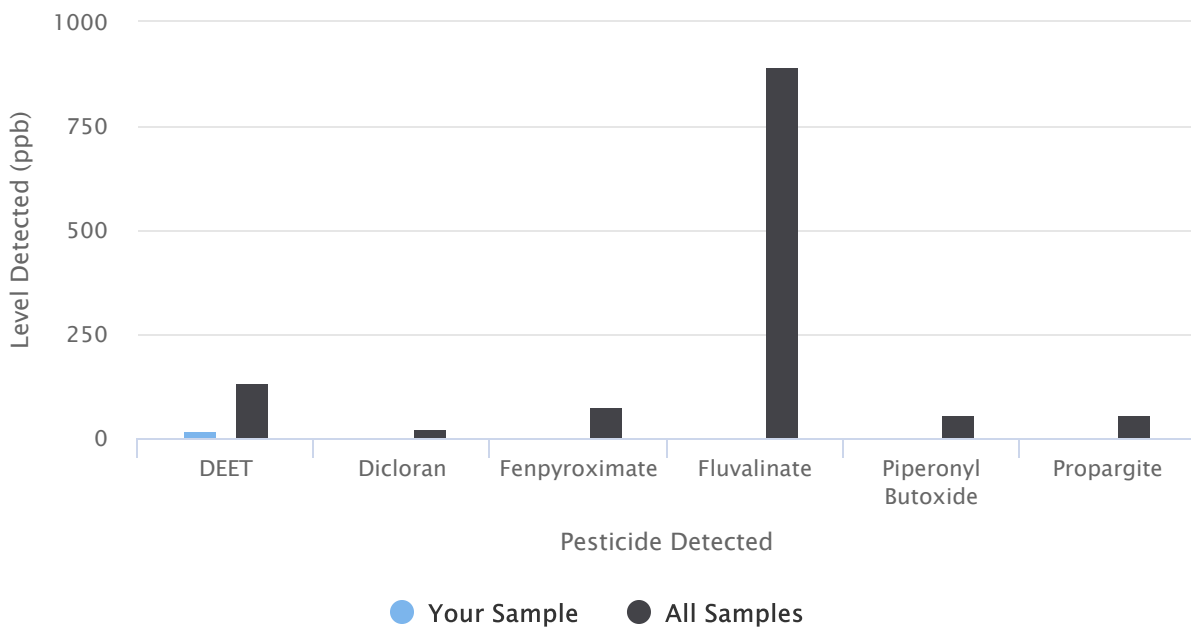
<sup>2</sup>Level of Detection (LOD) of the screening process (the minimum amount that can be reliably detected).

<sup>3</sup>Level of the specific pesticide (in parts per billion (ppb)) detected in sampled colonies.

<sup>4</sup>National averages of positively detected pesticides in ppb.

<sup>5</sup>Prevalence, or percentage, that the specific pesticide was detected in all samples.

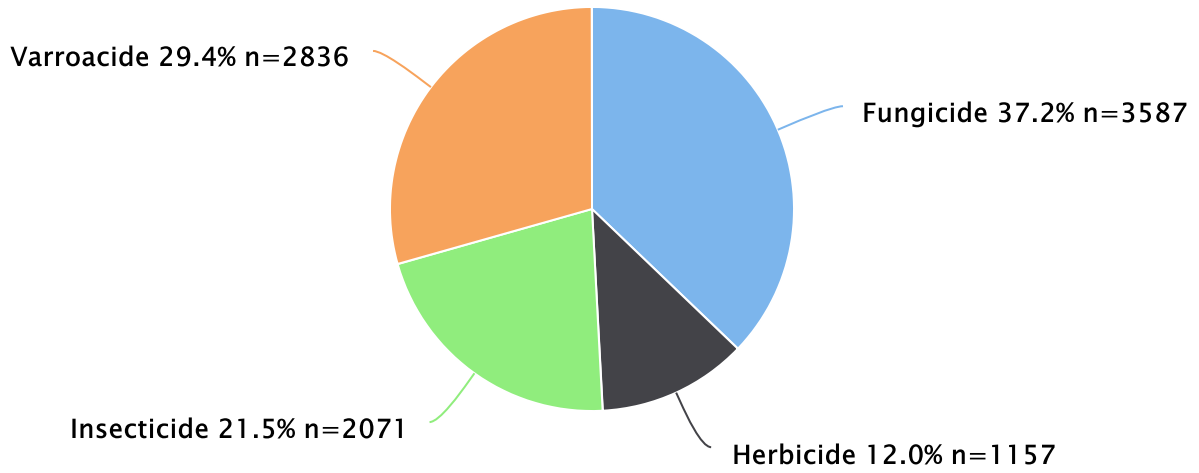
**Chart 1: Comparison of Pesticide Levels in your Wax Sample vs. The National Honey Bee Disease Survey Average (n=664)**



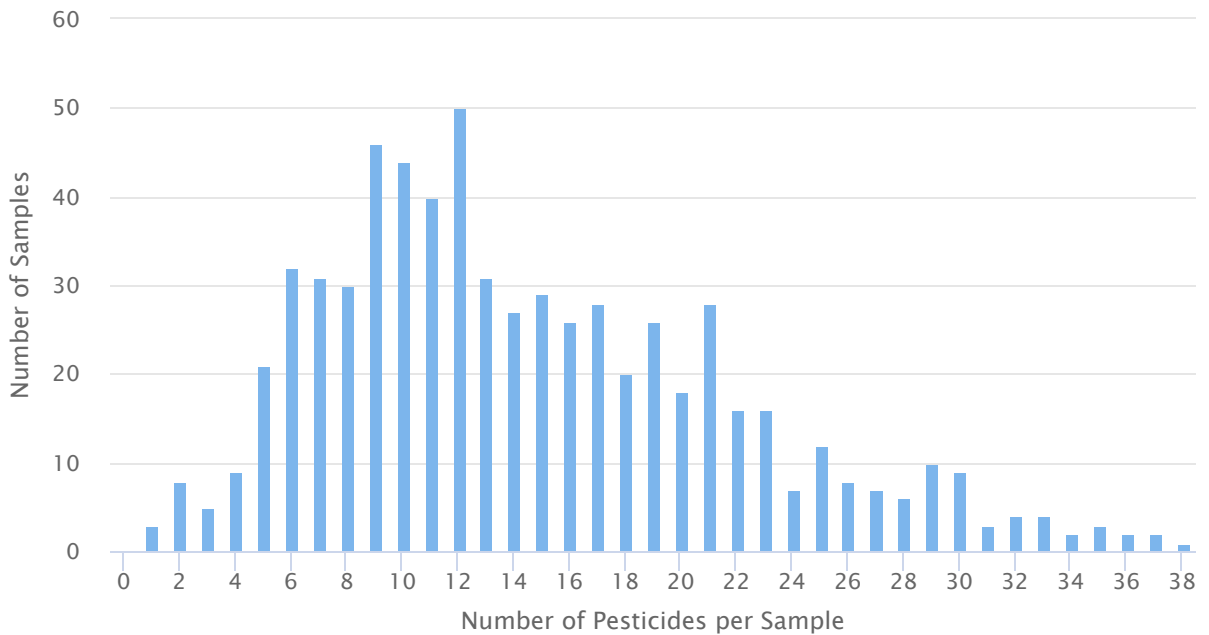
### Chart 2: Overall Distribution of Categories of Pesticides in National Survey Wax Samples (n=664)



Each sample can be positive for multiple pesticides, therefore a higher number of detections per category than samples is possible.



### Chart 3: Histogram of Number of Pesticide Samples Detected per Wax Sample (n=664)



**Table 2: Prevalence of Pesticides found in all samples (n= 664) analyzed for the National Honey Bee disease survey.**

\*Only a single detection made for this pesticide.

Pesticide Detected	LOD (ppb)	# Samples	Prevalence (%)	Average Level (ppb)	Level Range
1-Naphthol	50.0-500.0	664	0.2	430.0	430.0
2,4 Dimethylphenyl formamide (DMPF)	1.5-5.0	365	69.3	2365.3	Trace - 78900.0
2,4-DMPF	25.0	299	72.9	2708.2	Trace - 69900.0
2,6-Dichlorobenzamide (BAM)	4.0-5.0	652	1.4	33.6	Trace - 179.0
4-Hydroxychlorothalonil	2.0-10.0	365	0.5	22.0	19.0 - 25.0
4-OH-Chlorothalonil	5.0	299	0.3	Trace	Trace*
Acephate	25.0-250.0	664	0.2	51.0	51.0
Acetamiprid	2.5-8.0	664	3.0	10.3	Trace - 19.0
Acetochlor	15.0-100.0	664	19.7	275.4	Trace - 740.0
Alachlor	15.0-200.0	664	1.1	133.4	Trace - 186.0
Aldrin	30.0	12	8.3	99.0	99.0
Ametoctradin	1.0-3.0	652	3.7	10.9	Trace - 70.0
Atrazine	3.0-4.0	664	26.5	17.6	Trace - 214.0
Azinphos-methyl	250.0	353	1.7	1576.0	Trace - 2670.0
Azoxystrobin	1.0-5.0	664	52.0	32.8	Trace - 1070.0
Bensulide	4.0-5.0	652	0.2	Trace	Trace*
Bifenazate	3.0-15.0	664	1.2	15.8	Trace - 31.0
Bifenthrin	10.0-25.0	664	1.2	128.4	Trace - 315.0

<b>Pesticide Detected</b>	<b>LOD (ppb)</b>	<b># Samples</b>	<b>Prevalence (%)</b>	<b>Average Level (ppb)</b>	<b>Level Range</b>
Boscalid	5.0-10.0	664	20.8	27.4	Trace - 232.0
Bromacil	10.0-20.0	664	1.1	14.5	Trace - 17.0
Buprofezin	2.0-60.0	664	12.0	26.0	Trace - 543.0
Captan	50.0-250.0	664	1.1	455.2	Trace - 1000.0
Carbaryl	2.0-5.0	664	5.9	64.9	Trace - 452.0
Carbendazim	2.0-25.0	652	49.4	105.7	Trace - 2510.0
Carbendazim (MBC)	5.0	12	83.3	39.5	Trace - 130.0
Carbofuran	1.0-10.0	664	0.3	4.0	4.0 - 4.0
Chlorantraniliprole	13.0-15.0	664	10.8	31.1	Trace - 59.0
Chlorfenapyr	250.0	353	0.3	Trace	Trace*
Chlorfenopyr	5.0-13.0	311	0.6	Trace	Trace - Trace
Chlorothalonil	50.0-250.0	664	34.2	2599.1	Trace - 57400.0
Chlorpropham	15.0	652	0.2	Trace	Trace*
Chlorpyrifos	5.0	664	29.8	21.8	Trace - 273.0
Chlorthal-dimethyl	3.0	299	15.7	10.0	Trace - 30.0
Chlorthal-dimethyl (DCPA)	2.0	353	12.2	6.0	Trace - 20.0
Coumaphos	3.0-5.0	664	89.8	217.4	Trace - 9310.0
Coumaphos oxon	0.5-2.0	664	58.3	20.1	Trace - 1050.0
Cyantraniliprole	13.0-25.0	664	0.3	44.0	Trace - 44.0

<b>Pesticide Detected</b>	<b>LOD (ppb)</b>	<b># Samples</b>	<b>Prevalence (%)</b>	<b>Average Level (ppb)</b>	<b>Level Range</b>
Cymoxanil	4.0	652	0.2	Trace	Trace*
Cypermethrin	10.0-25.0	659	0.6	Trace	Trace - Trace
Cyprodinil	2.0-10.0	664	37.0	78.2	Trace - 3780.0
Cyromazine	5.0-25.0	365	0.3	Trace	Trace*
DDE p,p'	3.0-5.0	304	21.7	7.0	Trace - 9.0
DDE, p,p'	2.0	353	11.0	17.0	Trace - 18.0
DEET	3.0-13.0	652	31.4	136.9	Trace - 3850.0
Dichlorvos	5.0	299	0.3	8.0	8.0
Dichlorvos (DDVP)	3.0-15.0	365	0.3	4.0	4.0
Dicloran	5.0-25.0	664	2.4	26.0	Trace - 27.0
Dicofol	5.0-250.0	664	0.3	Trace	Trace - Trace
Difenoconazole	4.0-10.0	664	15.7	16.7	Trace - 129.0
Diflubenzuron	2.0-5.0	664	14.9	105.1	Trace - 7240.0
Dimethenamid	4.0-10.0	664	0.9	5.7	Trace - 6.0
Dimethoate	2.0-15.0	664	1.7	26.6	Trace - 101.0
Diphenylamine	2.0-3.0	652	13.7	5.9	Trace - 16.0
Diuron	1.0-6.0	664	33.1	11.9	Trace - 203.0
Endosulfan II	10.0-25.0	664	0.8	Trace	Trace - Trace
Endosulfan sulfate	10.0-25.0	664	0.2	Trace	Trace*
Esfenvalerate	5.0-13.0	311	1.0	22.0	Trace - 22.0

<b>Pesticide Detected</b>	<b>LOD (ppb)</b>	<b># Samples</b>	<b>Prevalence (%)</b>	<b>Average Level (ppb)</b>	<b>Level Range</b>
Ethofenprox	125.0	299	8.0	Trace	Trace - Trace
Etofenprox	5.0-25.0	365	0.3	81.0	81.0
Etoxazole	0.5-5.0	664	0.8	3.3	Trace - 4.0
Famoxadone	5.0-25.0	664	0.3	11.0	Trace - 11.0
Fenamidone	1.0-30.0	664	2.9	3.0	Trace - 4.0
Fenazaquin	1.0-5.0	664	0.2	2.0	2.0
Fenbuconazole	3.0-15.0	664	13.7	42.5	Trace - 705.0
Fenhexamid	4.0-30.0	664	0.5	317.7	79.0 - 770.0
Fenpropathrin	10.0-25.0	664	0.2	Trace	Trace*
Fenpyroximate	3.0-4.0	664	48.2	76.5	Trace - 4740.0
Fipronil sulfide	5.0	664	0.2	Trace	Trace*
Fipronil sulfone	5.0-25.0	664	0.2	Trace	Trace*
Flonicamid	7.0-38.0	664	0.8	74.0	Trace - 118.0
Fludioxonil	10.0-60.0	664	9.0	309.2	Trace - 5850.0
Flumeturon	2.0	299	21.1	3.6	Trace - 13.0
Fluometuron	1.0-40.0	358	0.3	Trace	Trace*
Fluopicolide	3.0	652	1.4	6.5	Trace - 16.0
Fluopyram	1.0-5.0	664	26.4	26.3	Trace - 503.0
Fluoxastrobin	2.0-5.0	664	0.5	6.5	Trace - 10.0
Flupyradifurone	5.0-25.0	664	2.7	67.9	Trace - 403.0
Flutriafol	5.0-10.0	652	0.2	18.0	18.0



<b>Pesticide Detected</b>	<b>LOD (ppb)</b>	<b># Samples</b>	<b>Prevalence (%)</b>	<b>Average Level (ppb)</b>	<b>Level Range</b>
Fluvalinate	5.0-50.0	664	74.1	896.6	Trace - 76800.0
Fluxapyroxad	2.0	652	16.9	9.9	Trace - 158.0
Hexazinone	1.0-10.0	664	0.6	2.0	Trace - 3.0
Hexythiazox	1.0-15.0	664	22.3	3.6	Trace - 26.0
Imazalil	10.0-20.0	664	0.2	46.0	46.0
Imidacloprid	5.0-6.0	664	1.1	14.5	Trace - 24.0
Indoxacarb	5.0-30.0	664	2.7	13.1	Trace - 32.0
Iprodione	50.0-100.0	664	34.5	308.2	Trace - 3370.0
Kresoxim-methyl	2.0-10.0	664	0.6	9.0	Trace - 9.0
MGK-264	7.0-25.0	365	2.7	26.4	Trace - 52.0
Malathion	10.0-25.0	664	1.8	337.7	Trace - 939.0
Mandipropamide	2.0-10.0	664	2.9	7.2	Trace - 28.0
Metalaxyl	1.0-5.0	659	3.9	9.1	Trace - 29.0
Metalaxyl Total	5.0	5	20.0	Trace	Trace*
Metconazole	5.0-10.0	664	3.5	43.8	Trace - 159.0
Methomyl	3.0-25.0	664	0.2	8.0	8.0
Methoprene	80.0-5000.0	664	2.6	5582.0	Trace - 6300.0
Methoxyfenozide	1.0-5.0	664	23.8	31.9	Trace - 1020.0
Metolachlor	5.0-25.0	664	42.0	80.7	Trace - 521.0
Metribuzin	5.0-25.0	664	0.5	Trace	Trace - Trace

<b>Pesticide Detected</b>	<b>LOD (ppb)</b>	<b># Samples</b>	<b>Prevalence (%)</b>	<b>Average Level (ppb)</b>	<b>Level Range</b>
Mgk-264	20.0	299	2.0	1274.5	Trace - 2450.0
Momfluorothrin	25.0	652	0.2	28.0	28.0
Myclobutanil	7.0-15.0	664	0.6	86.0	Trace - 129.0
Norflurazon	5.0-15.0	664	1.1	27.0	Trace - 27.0
Norflurazon Desmethyl	5.0	299	0.7	11.0	Trace - 11.0
Norflurazon desmethyl	5.0-25.0	365	0.5	Trace	Trace - Trace
Novaluron	5.0-30.0	664	4.7	13.3	Trace - 54.0
Omethoate	12.0-100.0	664	1.1	1220.3	210.0 - 3350.0
Oxamyl	10.0-20.0	664	0.2	Trace	Trace*
Oxyfluorfen	5.0-100.0	664	2.7	64.9	Trace - 388.0
Pendimethalin	15.0-50.0	664	7.7	52.0	Trace - 234.0
Penthiopyrad	1.0-2.0	652	23.3	14.3	Trace - 203.0
Permethrin	50.0-100.0	652	1.5	1598.0	Trace - 3360.0
Phosmet	50.0-100.0	664	0.3	388.0	Trace - 388.0
Picoxystrobin	2.0-3.0	652	0.5	22.0	5.0 - 56.0
Piperonyl Butoxide	6.0	299	67.9	59.2	Trace - 3290.0
Piperonyl butoxide	12.0-15.0	365	57.3	210.7	Trace - 2620.0
Prallethrin	13.0-250.0	664	1.4	109.4	17.0 - 415.0
Prodimine	10.0-100.0	664	0.3	40.5	21.0 - 60.0

<b>Pesticide Detected</b>	<b>LOD (ppb)</b>	<b># Samples</b>	<b>Prevalence (%)</b>	<b>Average Level (ppb)</b>	<b>Level Range</b>
Prometon	1.0-3.0	652	6.1	20.1	Trace - 293.0
Prometryn	3.0-4.0	652	0.5	8.0	Trace - 8.0
Propamocarb hydrochloride	2.0	353	6.2	15.4	Trace - 127.0
Propanil	5.0-10.0	664	1.4	29.4	Trace - 64.0
Propargite	2.0-15.0	664	43.2	56.9	Trace - 2710.0
Propiconazole	2.0-15.0	664	22.9	43.7	Trace - 1050.0
Pyraclostrobin	2.0-5.0	664	41.7	23.6	Trace - 415.0
Pyridaben	2.0-5.0	664	3.3	19.9	Trace - 96.0
Pyrimethanil	5.0-15.0	664	17.5	41.4	Trace - 1080.0
Pyriproxyfen	1.0-5.0	664	3.8	7.6	Trace - 30.0
Quinoxifen	2.0-15.0	664	2.0	6.7	Trace - 15.0
Simazine	20.0-50.0	664	0.2	59.0	59.0
Spinetoram	15.0-100.0	365	3.6	16.0	Trace - 16.0
Spinosad	7.0-15.0	365	6.0	22.8	Trace - 40.0
Spirodiclofen	4.0-5.0	664	8.1	7.1	Trace - 17.0
Spiromesifen	25.0-50.0	664	0.2	42.0	42.0
Spirotetramat	2.0-30.0	664	0.9	4.5	Trace - 5.0
Sulfoxaflor	10.0-25.0	664	0.2	Trace	Trace*
THPI	15.0-125.0	664	0.5	816.7	270.0 - 1880.0
Tebuconazole	5.0-25.0	664	15.2	45.6	Trace - 201.0

<b>Pesticide Detected</b>	<b>LOD (ppb)</b>	<b># Samples</b>	<b>Prevalence (%)</b>	<b>Average Level (ppb)</b>	<b>Level Range</b>
Tebufenozide	0.5-5.0	664	6.5	19.6	Trace - 196.0
Tetramethrin	30.0-125.0	664	0.9	10891.8	901.0 - 30600.0
Thiabendazole	5.0	664	1.1	32.0	Trace - 38.0
Thiacloprid	2.0-5.0	664	0.6	15.0	Trace - 15.0
Thymol	2.0-50.0	664	77.6	12222.4	Trace - 1440000.0
Trifloxystrobin	1.0-10.0	664	38.7	13.2	Trace - 257.0
Triflumizole	1.0-40.0	664	3.6	5.5	1.0 - 24.0
Trifluralin	5.0-13.0	664	3.6	21.7	Trace - 27.0
cyhalothrin lambda	50.0	299	1.3	Trace	Trace - Trace

\*Only a single detection made for this pesticide.

The following list the 193 pesticides tested for in this sample.

Vinclozolin, Triconazole, Trifluralin, Triflumizole, Trifloxystrobin, Tribufos, Triazophos, Triadimenol, Triadimefon, Tolfenpyrad, Thymol, THPI, Thiamethoxam, Thiacloprid, Thiabendazole, Tetramethrin, Tetradiafon, Tetraconazole, Tefluthrin, Tebuthiuron, Tebufenozide, Tebuconazole, Sulfoxaflor, Spirotetramat, Spiromesifen, Spirodiclofen, Simazine, Sethoxydim, Resmethrin, Quintozine, Quinoxifen, Pyriproxyfen, Pyrimethanil, Pyridaben, Pyraclostrobin, Pymetrozine, Propiconazole, Propetamphos, Propazine, Propargite, Propanil, Propachlor, Pronamide, Prometryn, Prometon, Profenofos, Prodiamine, Prallethrin, Piperonyl Butoxide, Picoxystrobin, Phosmet Oa, Phosmet, Phosalone, Phorate, Phenothrin, Permethrin, Penthiopyrad, Pendimethalin, Penconazole, Parathion methyl, Parathion, Oxyfluorfen, Oxamyl, Omethoate, Novaluron, Norflurazon Desmethyl, Norflurazon, Myclobutanil, Momfluorothrin, Mkg-264, Metribuzin, Metolachlor, Methoxyfenozide, Methoprene, Methomyl, Methidathion, Methamidophos, Metconazole, Metalaxyl, Mandipropamide, Malathion, Linuron, Kresoxim-methyl, Iprodione, Indoxacarb, Imidacloprid, Imazalil, Hexythiazox, Hexazinone, Fluxapyroxad, Fluvalinate, Flutriafol, Fluridone, Flupyradifurone, Fluoxastrobil, Fluopyram, Fluopicolide, Flumeturon, Fludioxonil, Flonicamid, Fipronil sulfone, Fipronil sulfide, Fipronil, Fenpyroximate, Fenpropathrin, Fenoxaprop-ethyl, Fenhexamid, Fenbuconazole, Fenazaquin, Fenarimol, Fenamidone, Famoxadone, Etoxazole, Ethofumesate, Ethofenprox, Ethion, Esfenvalerate, Epoxiconazole, Endosulfan sulfate, Endosulfan II, Endosulfan I, Diuron, Diphenylamine, Diphenamid, Dinotefuran, Dimethomorph, Dimethoate, Dimethenamid, Diflubenzuron, Difenconazole, Dicofof, Dicloran, Dichlorvos, Diazinon oxon, Diazinon, Deltamethrin, DEET, DDE p,p', Cyprodinil, Cyphenothrin, Cypermethrin, Cymoxanil, Cymiazole, cyhalothrin lambda, Cyfluthrin, Cyflumetofen, Cyflufenamid, Cyazofamid, Cyantraniliprole, Coumaphos oxon, Coumaphos, Clothianidin, Clofentezine, Chlorthal-dimethyl, Chlorpyrifos methyl, Chlorpyrifos, Chlorpropham, Chlorothalonil, Chlorfenvinphos, Chlorfenopyr, Chlorantraniliprole, Carfentrazone-ethyl, Carbofuran, Carbendazim, Carbaryl, Captan, Buprofezin, Bromuconazole, Bromopropylate, Bromacil, Boscalid, Bifenthrin, Bifenazate, Bentazone, Bensulide, Azoxystrobin, Azinphos methyl, Avermectin, Atrazine, Ametoctradin, Aldicarb sulfoxide, Aldicarb sulfone, Aldicarb, Alachlor, Acrinathrin, Acetochlor, Acetamiprid, Acephate, 4-OH-Chlorothalonil, 3-hydroxycarbofuran, 2,6-Dichlorobenzamide (BAM), 2,4-DMPF, 1-Naphthol

\* K.S. Traynor, J.S. Pettis, D.R. Tarpy, C.A. Mullin, J.L. Frazier, M. Frazier, D. vanEngelsdorp, In-hive Pesticide Exposome: Assessing risks to migratory honey bees from in-hive pesticide contamination in the Eastern United States, *Scientific Reports*. 6 (2016) srep33207. doi:10.1038/srep33207.