DEPARTMENT OF AGRICULTURE

Pesticide Bee Kill Complaint Investigations

Summary of investigations in 2022

Contents

Background

Under Minnesota Statute 18D.201, the Minnesota Department of Agriculture (MDA) is the state agency responsible for investigating bee kill incidents alleged to be caused by pesticides. The MDA's Pesticide and Fertilizer Management Division conducts the investigations.

Under Minnesota Statute 18B.055, the MDA must compensate a bee owner for an acute pesticide poisoning resulting in the death of bees or loss of bee colonies owned by the bee owner with some stipulations. In any fiscal year, a bee owner must not be compensated for a claim that is less than $100 or compensated more than $20,000 for all eligible claims.

Effective August 01, 2015, the Minnesota Legislature added a provision requiring a bee owner to be registered with a commonly utilized pesticide registry program, as designated by the commissioner in order to be eligible for compensation. The Commissioner of Agriculture has designated Beecheck, (https://beecheck.org/), a voluntary hive mapping registry administered by FieldWatch, as the required registry program.

Program Details

The MDA investigates alleged bee kills. A written complaint must be made to start the process, Pesticide and Fertilizer Misuse Complaint webpage.

Upon receipt of a written complaint, MDA staff will review the information to determine if there is sufficient evidence for a field investigation. If sufficient evidence is available, the MDA will send out a team of trained pesticide investigators. The team has expertise in bee handling/colony assessment.

During the investigation, samples of dead bees, live bees, and plant material, as available and appropriate, are collected to evaluate the presence of pesticides, colony pests, and overall colony health. In addition, the MDA attempts to determine the extent of pesticide use in areas adjacent to hive locations by contacting pesticide dealers, growers, and applicators in the area.

The MDA Laboratory Services Division is a state Insecticide Fungicide Rodenticide Act (FIFRA) laboratory and analyzes MDA samples for pesticide residues. The laboratory is accredited for ISO 17025 by A2LA. Samples are also analyzed by the United States Department of Agriculture Lab in Gastonia, North Carolina.

The Bee Informed Partnership evaluates bee samples for *Varroa destructor*, a mite known to vector viruses and reduce bee longevity, and *Nosema spp*., a fungal pathogen that can infect a bee's gut. The Bee Informed Partnership lab also analyzes bees for common viruses that negatively affect bees.

Once the Pesticide and Fertilizer Management Division receives analytical results for pesticides, mites, and viruses, staff confer internally to determine what likely contributed to the death of the bees.

For bee kill incidents, the MDA uses a working definition of "acute pesticide poisoning" to capture acute pesticide effects on honey bee colonies with different populations and developmental stages. The MDA evaluates an "acute pesticide poisoning" based on the presence of non-beekeeper-applied pesticide residues in dead bees, the number of bee frames of bees (a measure of a honey bee colony's living population), and a minimum number of dead bees present in and around the hive at the time of the investigation.

- For a pesticide-related bee kill to be considered an “acute pesticide poisoning,” a colony with three or fewer frames of bees present in the hive at the time of investigation must have at least 300 total dead bees in and around the colony.
- Colonies with between 3.5 and 9.5 frames of bees at the time of investigation will need between 350 and 950 dead bees to be considered an “acute pesticide poisoning” (50 dead bees for every 0.5 frames of bees).
- If a colony has ten or more frames of bees at the time of investigation, a maximum of 1,000 dead bees must be quantified to be considered an “acute pesticide poisoning.”

If it can be demonstrated that pesticides likely led to an “acute pesticide poisoning” and the apiary was registered on BeeCheck prior to the bee kill incident, the beekeeper may be eligible for compensation according to Minn. Stat 18B.055.

The MDA currently does not have a statewide apiary program for pollinator health inspections and does not require the registration of apiaries with the state.

Program Contacts

For pesticide misuse complaint information:
Christine Wicks 651-201-6390

For bee kill compensation information:
Jamison Scholer 651-201-6303

Summary of 2022 Bee Kill Incidents

The MDA investigated one bee kill incident in 2022. It was determined to be an acute pesticide poisoning and the beekeeper was compensated for nine hives. See below for further details.

Investigation Summary

Meeker County **Case File Number:** SRK141003855

Received date: June 23, 2022

Date	June 23, 2022	June 28, 2022	June 28, 2022	Sept. 21, 2022	Oct. 31, 2022	Nov. 23, 2022	Jan. 20, 2023	Nov. 20, 2023
Action	Call received	MDA responds	Samples sent to labs for analysis	USDA bee residue results received	MDA bee residue results received	MDA/USDA bee residue results sent to beekeeper	Compensation claim request received from beekeeper	Case closing letter issued

Background of Bee Kill Incident and MDA Response

- The apiary consisteded of nine honey bee colonies considered affected.
- There was a large pile of dead bees in and around the affected colonies. Affected, live bees displayed uncoordinateded, weakened movement and were first observed by the beekeeper on the morning of June 23, 2022.
- The incident was reported to the MDA on June 23, 2022 and an MDA Agricultural Chemical Investigator and MDA Pesticide Technical Unit staff entomologist visited the site on June 28, 2022.
- The apiary was located across the street from an alfalfa field.
- No rainfall occurred between the time of the complaint and the time of the on-site investigation.

MDA Colony Health Findings

- Two colonies were evaluated for colony health, one represented colonies considered more affected (3 colonies) and one represented colonies considered less affected (6 colonies) by the beekeeper. The number of live bee frames per box averaged nine frames of live bees per deep brood box. The measured population established an acute pesticide poisoning threshold of 900 dead bees for this case.
- The number of dead bees collected near affected hives exceeded 1,000 individuals.
- Brood pattern, an indicator of the queen's health and colony productivity, scored 4 out of 5 suggesting a good egg-laying pattern in affected colonies.
- No disease symptoms were observed.
- 0.47 – 0.70 *Varroa* mites/100 bees were found in the affected colony, which was below the recommended seasonal treatment threshold of 2 mites/100 bees.
- 0 – 0.4 million *Nosema* spores/bee were found in the affected colony, which was below the 1.0 million spores/bee threshold at which adverse effects from *Nosema* are thought to be observable in colonies.
- Worker bees from affected colonies were evaluated for 12 honey bee viruses through RNA quantification and compared to national prevalence rates. Percentiles, shown in parenthesis, allow for comparison of viral loads from sampled hives against nationally compiled prevalence rates, where smaller percentiles indicate less pressure from a particular virus. Black queen cell virus (58-93/100), Israeli acute paralysis virus (40/100), Sacbrood virus (36-84/100), Varroa destructor virus-B (31/100), and Lake Sinai virus 2 (55/100) were found. Understanding how viruses act as a stressor toward honey bee colony health continues to be an area of active research. Viral loads quantified here indicate a level of pressure below or above the national median, depending on the virus.

MDA Pesticide Findings

- Pesticide residue analyses were carried out at the MDA laboratory for dead bee, live bee, and vegetation samples. The USDA laboratory analyzed pesticide residues for dead and live bee samples.
- The MDA laboratory pesticide residue results found clothianidin, dimethoate, cyhalothrin, and omethoate in dead bees while amitraz DMPMF, dimethoate, and omethoate were found in live bees. A vegetation sample consisting of grasses collected near the most affected hives contained dimethoate and omethoate.
- The USDA laboratory pesticide residue results found amitraz 2,4-DMPF, dimethoate, lambda-cyhalothrin, metolachlor, omethoate, and thymol in dead bees. No quantifiable pesticide residues were found in live bees analyzed.
- The beekeeper applied oxalic acid to honey bee colonies within the last 12 months for *Varroa* mite control and provided the product label.
- Differences in pesticide residue results between the MDA and USDA laboratories can be due to differences in sample composition, analytical methods and/or different levels of detection between laboratories. Laboratory results are displayed in the table below.

Laboratory Results – Pesticide Residue Analysis*

Lab	Active Ingredient (Level of detection*)	Type of pesticide	Concentration from affected dead bees* (% acute benchmark^)	Concentration from affected live bees* (% acute benchmark^)	Concentration from vegetation* (% acute benchmark^)	Adult honey bee acute LD_{50}* (EPA ecotoxicity category)
MDA	amitraz DMPMF (0.40)	insecticide/acaricide degradate	No Detection	0.80 - 0.83 (<0.0003%)	No Detection	Parent contact: >781,250[1] (Practically non-toxic)
USDA	amitraz 2,4-DMPF (25)	insecticide/acaricide degradate	Trace (<0.01%)	No Detection	Not Screened	Parent contact: >781,250[1] (Practically non-toxic)
MDA	clothianidin (0.40)	insecticide	0.46 (≈4%)	No Detection	No Detection	Oral: 29 [2] (Highly toxic)
USDA	clothianidin (8.0)	insecticide	No Detection	No Detection	Not Screened	Oral: 29 [2] (Highly toxic)
MDA	dimethoate (0.40)	insecticide/acaricide	282 –365 (≈161% - ≈208%)	1.64 –8.07 (≈1% - ≈5%)	462 (≈264%)	Oral: 438 [3] (Highly toxic)
USDA	dimethoate (5)	insecticide/acaricide	153 – 504 (≈87% - ≈288%)	Trace (<3%)	Not Screened	Oral: 438 [3] (Highly toxic)
MDA	cyhalothrin (5)	insecticide	7.71 - 20.1 (≈26% - ≈67%)	No Detection	20.2 (≈67%)	Contact: 30 [4] (Highly toxic)
USDA	lambda-cyhalothrin (25)	insecticide	Trace – 28 (<83% - ≈93%)	No Detection	Not Screened	Contact: 30 [4] (Highly toxic)
MDA	metolachlor (0.025)	herbicide	No Detection	No Detection	No Detection	Oral: >664,063 [5] (Practically non-toxic)
USDA	metolachlor (25)	herbicide	Trace (<0.1)	No Detection	Not Screened	Oral: >664,063 [5] (Practically non-toxic)
MDA	omethoate (0.80)	insecticide/acaricide degradate	54.8 – 83.6 (≈37% - ≈56%)	0.61 –2.11 (≈0.4% - ≈1.4%)	65.6 (≈44%)	Contact: 375 [3] (Highly toxic)
USDA	omethoate (50)	insecticide/acaricide degradate	Trace (<33.33%)	No Detection	Not Screened	Contact: 375 [3] (Highly toxic)
MDA	thymol (NA)	biopesticide	Not Screened	Not Screened	Not Screened	Contact: 400,390 [6] (Practically non-toxic)
USDA	thymol (25)	biopesticide	108 (≈0.1%)	No Detection	Not Screened	Contact: 400,390 [6] (Practically non-toxic)

* All values are in µg/kg (microgram per killogram) which is equivalent to parts per billion (ppb).

^ Benchmark = EPA's toxicity value x EPA's acute Level of Concern (LOC) for adult honey bees. The EPA's toxicity value is the acute contact or oral Lethal Dose to 50% of a honey bee population (LD_{50}) in a standardized test (whichever value is lower) and the LOC is 0.4, a pre-determined threshold set for groups of organisms such as bees. Pesticide concentrations determined from the investigation's laboratory results are divided by the benchmark and expressed as a percentage.

[1] Amitraz Preliminary Ecological Risk Assessment and Endangered Species Assessment for Registration Review of the Conventional Use in Honey Bee Hives. 2018. DP Barcode: 435890

[2] Preliminary Bee Risk Assessment to Support the Registration Review of Clothianidin and Thiamethoxam. DP Barcode: 437097. USEPA. 2017. DP Barcode: 437097

[3] Registration Review Preliminary Ecological Risk Assessment for Dimethoate. 2015. DP Barcode: D421117

[4] Lambda-Cyhalothrin Transmittal of Four Data Evaluation Records for Bee Toxicity Studies and Updated Tier 1 Bee Risk Assessment. 2020. DP barcode: 457020

[5] Metolachlor/S-Metolachlor: Draft Ecological Risk Assessment for Registration Review. 2019. EPA-HQ-OPP-2014-0772-0028

[6] Registration Review Draft Risk Assessment for Thymol. 2019. EPA-HQ-OPP-2010-0002

Investigation Conclusions

- Five insecticides, amitraz 2,4-DMPF, clothianidin, dimethoate, cyhalothrin, and omethoate were found in dead bees. Concentrations of dimethoate exceeded EPA's acute benchmark used to determine risk to honey bees by ≈288%. While the insecticide cyhalothrin reached concentrations up to ≈93% of the acute benchmark.
- One herbicide, metolachlor, was found in dead bees in trace amounts <0.1% of the acute benchmark used to determine risk to honey bees.
- One biopesticide, thymol, typically applied by beekeepers was found in dead bees in low levels ≈0.1% of the acute benchmark used to determine risk to honey bees.
- Several viruses were found at elevated levels. It is possible that viruses acted as a stressor in the affected honey bees observed.

The investigation concluded that the observed bee mortality was due to an acute pesticide poisoning based on the ratio of live to dead bees and the quantity of insecticide residues found in dead bees. Over 1,000 dead bees were observed and out of the seven pesticide residues found in dead bees, four of the insecticides are considered highly toxic to honey bees. An Agricultural Chemical Investigator canvassed the area surrounding the apiary. A responsible party was found and the MDA took appropriate enforcement action for applying a pesticide inconsistent with the pesticide label.

Compensation

Because the beekeeper was registered with BeeCheck prior to the bee kill incident and the incident was determined to be an acute pesticide poisoning, they were eligible for compensation. The MDA received a completed Compensation Claim Form on January 20, 2023 and the beekeeper was compensated for the loss of nine honey bee hives at the 2022 fair market value established at $210.00/hive.

MDA and USDA Pesticide Analyte List Used in 2022 Bee Kill Investigations

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
1	1-Naphthol	Not screened	500
2	2,4 Dimethylphenyl formamide (DMPF)	Not screened	25
3	2, 6-Dichlorobenzamide (BAM)	Not screened	5
4	3-Hydroxycarbofuran	Not screened	5
5	Abamectin	32	Not screened
6	Acephate	9.6	50
7	Acetamiprid	0.08	8
8	Acetochlor	Not screened	100
9	Acrinathrin	Not screened	100
10	Afidopyropen	8.0	Not screened
11	Alachlor	Not screened	100
12	Aldicarb	32.0	8
13	Aldicarb sulfone	0.4	13
14	Aldicarb sulfoxide	0.8	25
15	Allethrin	1.6	Not screened
16	Amitraz DMPF	0.4	Not screened
17	Amitraz DMPMF	0.4	Not screened
18	Ametoctradin	Not screened	3
19	Atrazine	Not screened	3
20	Avermectin	Not screened	63
21	Azinphos methyl	Not screened	25
22	Azoxystrobin	Not screened	2
23	Bensulide	Not screened	5
24	Bentazon	Not screened	38
25	Bifenazate	0.4	4
26	Bifenthrin	4.8	25
27	Broflanilide	2.4	Not screened

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
28	Broflanilide DM-8007	1.6	Not screened
29	Boscalid	Not screened	5
30	Bromacil	Not screened	10
31	Bromopropylate	Not screened	25
32	Bromuconazole	Not screened	13
33	Buprofezin	Not screened	2
34	Captan	Not screened	125
35	Carbaryl	0.4	5
36	Carbendazim	Not screened	25
37	Carbofuran	0.4	2
38	Carbofuran, 3-Keto	0.4	Not screened
39	Carbofuran, 3-OH	2.4	Not screened
40	Carfentrazone-ethyl	Not screened	5
41	Chlorantraniliprole	0.8	13
42	Chlorfenopyr	Not screened	13
43	Chlorfenvinphos	Not screened	50
44	Chlorothalonil	Not screened	10
45	Chlorpropham (CIPC)	Not screened	15
46	Chlorpyrifos	Not screened	5
47	Chlorpyrifos methyl	Not screened	10
48	Chlorthal-dimethyl	Not screened	3
49	Clofentezine	8.0	13
50	Clothianidin	0.4	8
51	Coumaphos	Not screened	5
52	Coumaphos oxon	Not screened	1
53	Cyantraniliprole	2.4	13
54	Cyazofamid	Not screened	2
55	Cyflufenamid	Not screened	2
56	Cyflumetofen	Not screened	10
57	Cyfluthrin	5	25
58	Cyhalothrin (lambda)	5	25

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
59	Cymiazole	Not screened	8
60	Cymoxanil	Not screened	4
61	Cypermethrin	10	25
62	Cyphenothrin	10	1000
63	Cyprodinil	Not screened	3
64	DDE, p, p’	Not screened	3
65	DEET	Not screened	13
66	Deltamethrin/Tralomethrin	25	50
67	Diazinon	Not screened	25
68	Diazinon oxon	Not screened	4
69	Dichlorvos (DDVP)	Not screened	5
70	Dicloran	Not screened	25
71	Dicofol	Not screened	150
72	Difenoconazole	Not screened	4
73	Diflubenzuron	Not screened	3
74	Dimethenamid	Not screened	4
75	Dimethoate	0.4	5
76	Dimethomorph	Not screened	75
77	Dinotefuran	0.4	25
78	Dinotefuran UF	2.4	Not screened
79	Diphenamid	Not screened	3
80	Diphenylamine	Not screened	3
81	Diuron	Not screened	5
82	Emamectin Benzoate	2.4	Not screened
83	Endosulfan I	Not screened	25
84	Endosulfan II	Not screened	25
85	Endosulfan sulfate	Not screened	25
86	Epoxiconazole	Not screened	4
87	Esfenvalerate/Fenvalerate	10	13
88	Ethion	Not screened	25
89	Ethofenprox	Not screened	125

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
90	Ethofumesate	Not screened	15
91	Etofenprox	0.4	Not screened
92	Etoxazole	0.8	1
93	Famoxadone	Not screened	8
94	Fenamidone	Not screened	25
95	Fenarimol	Not screened	25
96	Fenazaquin	Not screened	1
97	Fenbuconazole	Not screened	3
98	Fenhexamid	Not screened	9
99	Fenoxaprop-ethyl	Not screened	4
100	Fenporpathrin	25	Not screened
101	Fenpropathrin	8.0	25
102	Fenpyroximate	Not screened	3
103	Fipronil	Not screened	25
104	Fipronil sulfide	Not screened	5
105	Fipronil sulfone	Not screened	25
106	Flonicamid	Not screened	38
107	Fludioxonil	Not screened	10
108	Flumethrin	10	Not screened
109	Flumeturon	Not screened	2
110	Fluopicolide	Not screened	3
111	Fluopyram	Not screened	2
112	Fluoxastrobin	Not screened	2
113	Flupyradifurone	0.8	5
114	Fluridone	Not screened	1
115	Flutriafol	Not screened	5
116	Fluvalinate	10	25
117	Fluxapyroxad	Not screened	2
118	Fonofos	0.025	Not screened
119	Hexazinone	Not screened	1
120	Hexythiazox	Not screened	1

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
121	lmazalil	Not screened	10
122	lmidacloprid	0.4	5
123	Imidacloprid des nitro olefin	2.4	Not screened
124	Imidacloprid desnitro (HCl)	2.4	Not screened
125	Imidacloprid olefin	1.6	Not screened
126	Imidacloprid urea	0.4	Not screened
127	Imidacloprid, 5-OH	3.2	Not screened
128	Imidprothrin	10	Not screened
129	lndoxacarb	Not screened	5
130	lprodione	Not screened	50
131	Kresoxim-methyl	Not screened	3
132	Linuron	Not screened	13
133	Malathion	0.025	25
134	Mandipropamide	Not screened	2
135	Metalaxyl Total	Not screened	2
136	Metazachlor	0.025	Not screened
137	Metconazole	Not screened	5
138	Methamidophos	0.025	25
139	Methidathion	0.025	2
140	Methiocarb	0.08	Not screened
141	Methiocarb sulfone	0.4	Not screened
142	Methiocarb sulfoxide	0.4	Not screened
143	Methomyl	0.4	5
144	Methomyl oxime	0.8	Not screened
145	Methomyl sulfoxide	9.6	Not screened
146	Methyl parathion	0.025	Not screened
147	Methoprene	Not screened	2500
148	Methoxyfenozide	Not screened	2
149	Metofluthrin	100	Not screened
150	Metolachlor	0.025	25
151	Metribuzin	0.025	13

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
152	Mevinphos	0.125	Not screened
153	MGK-264	Not screened	10
154	Momfluorothrin	Not screened	25
155	Monocrotophos	0.025	Not screened
156	Myclobutanil	Not screened	8
157	Nithiazine	2.4	Not screened
158	Norflurazon	Not screened	5
159	Norflurazon desmethyl	Not screened	5
160	Novaluron	9.6	5
161	Omethoate	0.8	50
162	Oxamyl	0.8	10
163	Oxamyl oxime	0.8	Not screened
164	Oxyfluorfen	Not screened	25
165	Parathion	Not screened	25
166	Parathion methyl	Not screened	25
167	Penconazole	Not screened	2
168	Pendimethalin	0.025	25
169	Penthiopyrad	Not screened	2
170	Permethrin	5	25
171	Phenothrin	10	100
172	Phophamidon-b	0.025	Not screened
173	Phorate	0.025	50
174	Phosalone	Not screened	25
175	Phosmet	0.025	50
176	Phosmet OA	Not screened	1
177	Picoxystrobin	Not screened	2
178	Piperonyl butoxide	Not screened	3
179	Pirimiphos-ethyl	0.025	Not screened
180	Pirimiphos-methyl	0.025	Not screened
181	Prallethrin	5	13
182	Prodiamine	Not screened	20

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
183	Profenofos	Not screened	5
184	Prometon	0.025	3
185	Prometryn	Not screened	3
186	Pronamide	Not screened	25
187	Propachlor	0.025	13
188	Propanil	Not screened	5
189	Propargite	Not screened	3
190	Propazine	0.025	5
191	Propetamphos	Not screened	5
192	Propiconazole	Not screened	5
193	Propoxur	0.8	Not screened
194	Pymetrozine	Not screened	250
195	Pyraclostrobin	Not screened	3
196	Pyridaben	0.32	3
197	Pyrofluquinazon	0.4	Not screened
198	Pyrimethanil	Not screened	5
199	Pyriproxyfen	Not screened	3
200	Quinoxyfen	Not screened	2
201	Quintozine	Not screened	5
202	Resmethrin	2	500
203	Sethoxydim	Not screened	3
204	Simazine	0.025	20
205	Spinetoram J	2.4	Not screened
206	Spinetoram L	2.4	Not screened
207	Spinosad A	0.8	Not screened
208	Spinosad D	8.0	Not screened
209	Spirodiclofen	Not screened	4
210	Spiromesifen	Not screened	38
211	Spirotetramat	Not screened	3
212	Sulfotep	0.025	Not screened
213	Sulfoxaflor	2.4	10

#	Analyte	MDA Limit of Detection*	USDA Limit of Detection*
214	Tebuconazole	Not screened	25
215	Tebufenozide	0.08	1
216	Tebuthiuron	Not screened	3
217	Tefluthrin	5	5
218	Terbufos	0.025	Not screened
219	Tetraconazole	Not screened	5
220	Tetradifon	Not screened	10
221	Tetramethrin	5	125
222	Thiabendazole	Not screened	5
223	Thiacloprid	0.4	3
224	Thiamethoxam	0.4	10
225	THPI	Not screened	125
226	Thymol	Not screened	25
227	Tioxazafen	9.6	Not screened
228	Tolfenpyrad	0.4	3
229	Triadimefon	Not screened	8
230	Triadimenol	Not screened	25
231	Triallate	0.025	Not screened
232	Triazophos	Not screened	2
233	Tribufos	Not screened	13
234	Trifloxystrobin	Not screened	1
235	Triflumizole	Not screened	2
236	Trifluralin	0.025	13
237	Triticonazole	Not screened	15
238	Vinclozolin	Not screened	5

Detection limits are calculated based on the instrumental minimum detectable amount.

* The detection limit was estimated based on the spike response and all values are in µg/kg (microgram per killogram) which is equivalent to parts per billion (ppb).