MINNESOTA DEPARTMENT OF AGRICULTURE
PESTICIDE AND FERTILIZER MANAGEMENT

April 2016

Summary of MDA Pesticide Bee Kill Complaint Investigations in 2015

Background

Under Minnesota Statutes, Chapter 18D.201, the Minnesota Department of Agriculture (MDA) is the state agency responsible for the investigation of bee kills alleged to be caused by pesticides. The MDA's Pesticide & Fertilizer Management Division conducts the investigations.

Effective July 01, 2014, the Minnesota Legislature appropriated $150,000 per fiscal year from the pesticide regulatory account to pay compensation claims for bees killed by pesticide. 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 that requires a bee owner to be registered with a commonly utilized pesticide registry program, as designated by the commissioner. The Commissioner of Agriculture has designated Beecheck, https://beecheck.org/, a voluntary hive mapping registry administered by FieldWatch.

Details

In order for the MDA to respond to an alleged pesticide bee kill, complaints must be reported in writing to the Pesticide & Fertilizer Management Division. A written complaint can be completed and submitted online at http://www.mda.state.mn.us/chemicals/pesticides/complaints/misusecomplaints.aspx

Upon receipt of a written complaint, the MDA sends a team of pesticide investigators with training in pesticide investigations, bee handling, and colony assessment to the site where the dead bees are located.

Samples of live/dead bees and other medium are taken to determine 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 through contacting pesticide dealers, growers and applicators in the area.

The MDA Laboratory Services Division (LSD) is a State Federal Insecticide Fungicide Rodenticide Act (FIFRA) laboratory and analyzes MDA samples for pesticide residues. Samples may also be analyzed by the USDA Lab in Gastonia, North Carolina who is under contract to the MDA.

The MDA also sends colony health samples to the University of Maryland to evaluate honey bee samples for the mite, *Varroa destructor*, known to vector viruses and reduce bee longevity; as well as the fungal pathogen, *Nosema* spp. that invades a bee's gut causing adverse effects. North Carolina State University evaluates samples for a set of bee viruses that cause adverse effects.

Once analytical results are received by the Pesticide & Fertilizer Management Division, the MDA confers internally regarding all evidence and attempts to determine the cause of the bee kill, as well as provide an underlying assessment of colony health. Individual investigation summaries are created for each bee kill.

For 2015 bee kill investigations, the MDA has modified its working definition of an "acute pesticide poisoning". Modifications are intended to more accurately predict "acute pesticide poisonings" of honey bee colonies at different developmental stages. The MDA evaluates an "acute pesticide poisoning" based on the presence of non-beekeeper applied pesticide residues present in dead bees; and the number of 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 3 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 quantified 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 .5 frame of bees).

- If a colony has 10 or more frames of bees at the time of investigation, a maximum of 1,000 dead bees need to be quantified to be considered an "acute pesticide poisoning".

If an investigation determines (1) pesticides are likely to have caused an "acute pesticide poisoning", (2) the apiary is in compliance with the pesticide registry program requirements, and (3) the damages claimed are documented or verifiable, the MDA considers the following compensation options:

- If the person who applied the pesticide can be identified and did so in a manner inconsistent with the pesticide product's label or labeling, the MDA may issue an enforcement action against the applicator that includes a financial penalty sufficient to compensate the beekeeper.

- If the person who applied the pesticide can be identified and made the application in a manner consistent with the pesticide product's label or labeling, then compensation to the beekeeper may be made from the pesticide regulatory account; or

- If an applicator cannot be identified, the MDA may compensate the beekeeper from the pesticide regulatory account.

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

Attachments

- Summaries for the four (4) pesticide bee kill complaints and the MDA's findings for 2015
- Terms and Definitions
- Pesticide Analyte Lists Used in Bee Kill Investigations

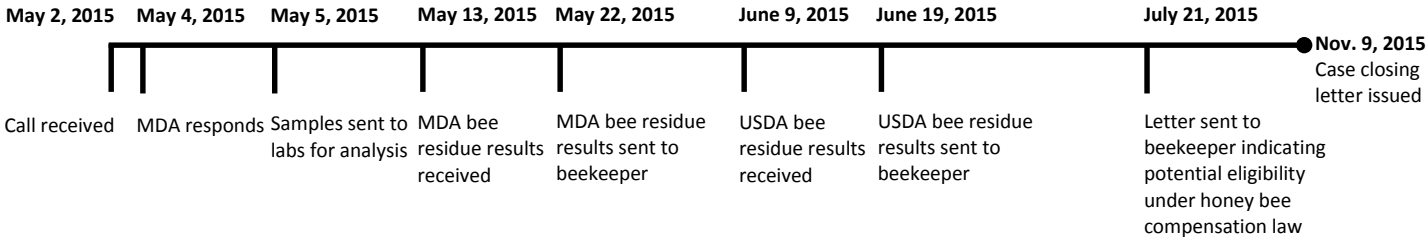
Program Contacts

For misuse complaint information:
Paul Haiker – (651) 201-6136
Christine Wicks – (651) 201-6390

For bee kill compensation information:
Jamison Scholer – (651) 201-6267
Gregg Regimbal – (651) 201-6671

Investigation Summary - Pesticide Bee Kill Complaint

Washington County, Scandia **Inspection: PTH128000429**
Received date: May 02, 2015



Background of Complaint and Minnesota Department of Agriculture (MDA) Response

- In mid-April a hobby beekeeper received and installed five (5) 2 pound "packages" into hive bodies consisting of a single deep. At the time of installing packages, colonies were fed a 50% sucrose solution and a pollen patty.
- The apiary was buffered from the field in question by a nearby stand of trees. The beekeeper reported piles of dead bees outside hive entrances, bees twitching, and a white residue on some of the bees.
- Investigators examined (opened) 3 of the 5 colonies and confirmed symptoms described by the beekeeper.
- Using two of the examined colonies, hive health samples were collected and combined to form composite samples used to evaluate colony stress from varroa, nosema, and virus (results pending).
- Using the same two colonies, frames of bees, brood pattern and observations of disease were made.

The MDA obtained composite samples (using the same colonies selected to evaluate hive health) for pesticide residue analysis. Composite samples included live bees taken from frames consisting of nectar and pollen and dead bees located in front of sampled colonies. A vegetative sample consisting of dandelion flowers was obtained from a ditch located on the north side of the field recently planted to corn and located nearest the apiary.

MDA Findings

- Colonies had a small amount of ejected larvae showing signs of chalk brood, a common early season fungal pathogen, and individual workers were seen with K-wing.
- Results from the varroa/nosema sample showed 0 varroa mites/303 bees indicating a low to non-existing varroa population. Individual bees had an average of 5.3 million nosema spores indicating some level of pressure.
- Colonies contained a mean of 5 frames of bees, indicating that a 500 dead bee threshold would be used as guidance to indicate an acute pesticide poisoning. Colonies had sustained an estimated population loss of ≈500 dead bees in and around hive entrances, and therefore meets the threshold for an acute pesticide poisoning.
- Colonies had a brood pattern of 2 to 3.

Pesticide Investigation

- The beekeeper did not apply pesticides to the hives in 2015 for purposes of apiary health.
- The beekeeper reported that corn planting occurred when winds blew toward the apiary.
- Pesticide analysis were carried out at the MDA Lab and the USDA Lab.
- MDA determined that corn seed treated with clothianidin insecticide was planted (on May 01, 2015) one day prior to the incidence being reported to the MDA (May 02, 2015).

Washington County, Scandia **Inspection: PTH128000429**

Laboratory Results

Active Ingredient (Laboratory)	Quantified sample concentration (µg/kg)		
	Affected dead bees	Affected live bees	Dandelion Flowers
	(% of acute oral benchmark)*		
Clothianidin(MDA)	2.39 ppb (16.1%)	No detection	16.3 ppb (110%)
Thymol (MDA)	Not analyzed	Not analyzed	Not analyzed
Clothianidin (USDA)	<LOQ**	No detection	Not analyzed
Thymol (USDA)	232 ppb (NA)	175 ppb (NA)	Not analyzed

* Benchmark = EPA's toxicity value x the Level of Concern (LOC). Where 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 is lower, and the LOC is 0.4. Laboratory results are divided by the benchmark and expressed as a percentage.

** Detection was below level of quantification (LOQ); USDA has higher level of quantification for clothianidin than the MDA Lab.

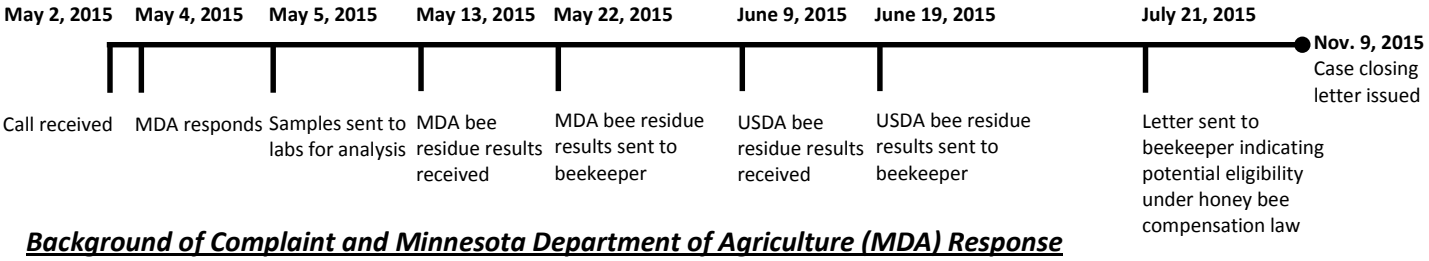
Conclusion

- Clothianidin residues were detected in dandelion flowers indicating that pesticide drift occurred on blooming plants.
- Corn seed treated with clothianidin was planted one day prior to the bee kill incidence being reported.
- Because of the high mortality of bees observed across affected colonies and associated presence of clothianidin residue in bees and on the vegetation, it is possible that the observed mortality was associated with direct exposure to the treated corn seed dust, or indirect exposure to contaminated pollen or nectar during foraging.
- Clothianidin residues detected on dead bees were relatively low, 6.5% of the honey bee acute oral LD_{50} established by the USEPA (16.1% of the benchmark). However, considerable degradation may have occurred due to rain and light exposure before samples were collected. Residues in dandelion flowers were 44.1% of clothianidin's acute oral LD_{50} value for honey bee (110% of the benchmark).
- When the case was closed, results were reported to the U.S.EPA.

Compensation **–** The beekeeper was compensated for loss of bees at the fair market value established for 2015.

Investigation Summary - Pesticide Bee Kill Complaint

Washington County, Scandia **Inspection: PTH128000432**
Received date: May 01, 2015



Background of Complaint and Minnesota Department of Agriculture (MDA) Response

- The hobby beekeeper had 5 colonies that were overwintered on site. The apiary was buffered from the field in question by a nearby stand of trees. The beekeeper reported piles of dead bees outside hive entrances and signs of pesticide poisoning.
- The apiary consisted of Russian colonies (a subspecies of the European honey bee) obtained from an East Coast breeder. Colonies were not fed at the beginning of spring as the beekeeper reported colonies had frames of honey and pollen remaining from winter. The beekeeper began feeding a 50% sugar syrup solution after the incidence.
- The beekeeper requested that colony health samples not be collected as the beekeeper already had the information from recent sampling.
- Investigators opened 2 of the 5 colonies and confirmed symptoms described by the beekeepers.
- Using the same two colonies, frames of bees, brood pattern and observations of disease were made.

The MDA obtained composite samples (using the same colonies selected to evaluate hive health) for pesticide residue analysis. Composite samples included live bees taken from frames consisting of nectar and pollen and dead bees located in front of sampled colonies. A vegetative sample consisting of dandelion flowers was obtained from a ditch located on the north side of the field recently planted to corn and located nearest the apiary.

MDA Findings

- Colonies contained a mean of 16 frames of bees, indicating that a 1,000 dead bee threshold would be used as guidance to indicate an acute pesticide poisoning. Colonies had sustained an estimated population loss of more than 1,000 dead bees in and around hive entrances, and therefore meets the threshold for an acute pesticide poisoning.
- Observed colonies had no visual signs of disease and were queen right.
- Colonies had a brood pattern of 4.

Pesticide Investigation

- The beekeeper did not apply pesticides to the hives in 2015 for purposes of apiary health.
- The beekeeper reported that corn planting occurred when winds blew toward the apiary.
- Pesticide analysis were carried out at the MDA Lab and the USDA Lab.
- MDA determined that corn seed treated with clothianidin insecticide was planted (on May 01, 2015) one day prior to the incidence being reported to the MDA (May 02, 2015).

Washington County, Scandia **Inspection: PTH128000432**

Laboratory Results

Active Ingredient (Laboratory)	Quantified sample concentration (µg/kg)		
	Affected dead bees	Affected live bees	Dandelion Flowers
	(% of acute benchmark)*		
Clothianidin (MDA)	2.45 ppb (16.6%)	No detection	16.3 ppb (110%)
Clothianidin (USDA)	<LOQ**	No detection	Not analyzed

* Benchmark = EPA's toxicity value x the Level of Concern (LOC). Where 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 is lower, and the LOC is 0.4. Laboratory results are divided by the benchmark and expressed as a percentage.

** Detection was below Level of quantification; USDA has higher level of quantification for clothianidin than the MDA Lab.

Conclusion

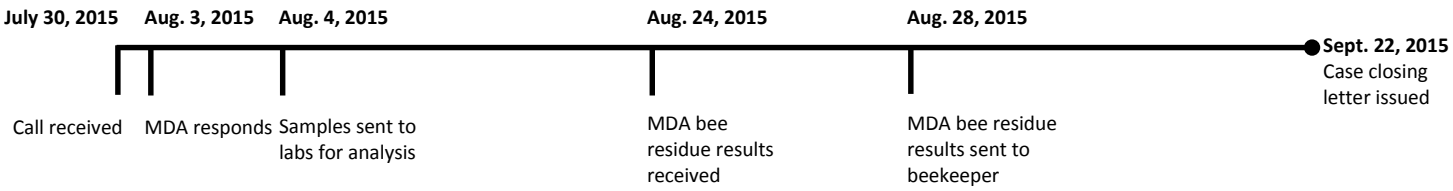
- Clothianidin residues were detected in dandelion flowers indicating that pesticide drift occurred on blooming plants from corn seed treated with clothianidin which was planted one day prior to the bee kill incidence.
- Because of high mortality of bees observed across affected colonies and associated presence of clothianidin residue in bees and on the vegetation, it is possible that the observed mortality was associated with direct exposure to the treated corn seed dust, or indirect exposure to contaminated pollen and nectar during foraging.
- Clothianidin residues detected on/in dead bees were relatively low, 6.6% of the honey bee acute oral LD_{50} established by the USEPA (16.6% of benchmark). However, considerable degradation may have occurred due to rain and light exposure before samples were collected. Residues in dandelion flowers were 44.1% of clothianidin's acute oral LD_{50} value for honey bee (110% of the benchmark).
- When the case was closed, results were reported to the U.S.EPA.

Compensation **–** The beekeeper was compensated for loss of bees at the fair market value established for 2015 and an upward adjustment was included to account for additional costs associated with Russian queens.

Investigation Summary - Pesticide Bee Kill Complaint

Otter Tail County, Wadena
Received date: July 30, 2015

Inspection: MUM108000274



Background of Complaint and Minnesota Department of Agriculture (MDA) Response

- A hobby beekeeper manages 2 colonies installed in 2015 as a "nuc" and a 3 pound "package".
- The apiary was adjacent to a soybean field allegedly sprayed.
- The beekeeper reported 400 to 500 dead bees outside hive entrances. Bees were cleaned up at the time of the incident.
- Investigators examined (opened) both colonies.
- Using the colony identified by the beekeeper as being affected the most, a live bee sample was taken.
- The beekeeper reported that the colonies looked healthy at the time of investigation.
- Due to the time that had passed (10 days) between the application in question and the investigation, no dead bees available for collection, and colonies appearing in good health, a full set of pesticide and colony health samples were not collected.

MDA Findings

- Upon analysis of the live bee sample, no pesticide residues were detected.
- No dead bees were present in/around hives for quantification or residue analysis.

Pesticide Investigation

- The beekeeper did not apply pesticides to the hives in 2015 for purposes of apiary health.
- Pesticide analysis was carried out at the MDA Lab.
- MDA determined that the soybean field in question was sprayed with Warhawk (chlorpyrifos) on July 25, 2015.

Laboratory Results

Active Ingredient (Laboratory)	Quantified sample concentration (µg/kg)
	Affected live bees
No Detection (MDA)	No Detection

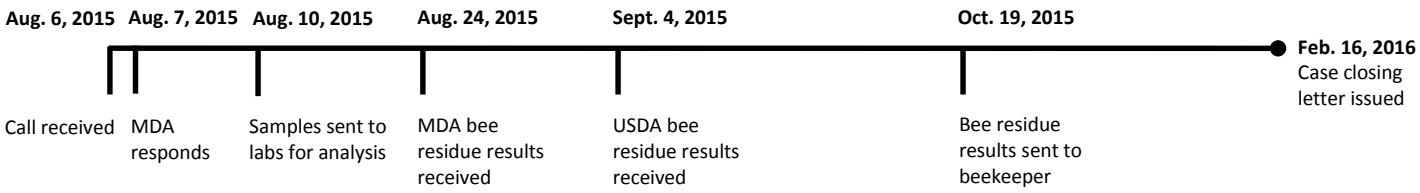
Conclusion

- The live bee sample did not have any pesticide residues present, indicating that foragers were likely not being exposed to residues from the adjacent field at the time of the investigation.
- Because of the lack of dead bees and pesticide residues present, the loss of bees cannot be connected to the pesticide application in question.
- Because no dead bees were present to quantify population loss nor test for pesticide residues, the beekeeper does not meet program requirements for compensation as an acute pesticide poisoning.

Compensation **–** The beekeeper did not meet compensation requirements.

Investigation Summary - Pesticide Bee Kill Complaint

Redwood County, Springfield **Inspection: KDR107000292**
Received date: August 07, 2015



Background of Complaint and Minnesota Department of Agriculture (MDA) Response

- A hobby beekeeper overwintered 5 colonies and split 3 colonies in the spring of 2015 for a total of 8 colonies present at the time of inspection.
- The beekeeper suspected recent aerial spraying of surrounding soybean fields between July 29 and August 06, 2015 to have caused an increased rate of mortality in their honey bee colonies.
- Investigators evaluated 2 of the 8 colonies with the greatest number of dead bees in front of a colony.
- Like samples from the 2 evaluated colonies were compiled into composite samples for pesticide residue (live bees, dead bees) and hive health (varroa, nosema, and virus) analysis.
- Using the same two colonies, frames of bees, brood pattern and observations of disease were made.
- The beekeeper reported a loss of 500 – 1000 bees for each of the 8 colonies.

MDA Findings

- Results from the varroa/nosema sample showed 6.1 varroa mites/100 bees indicating a level of pressure recommended for varroa mite control. Individual bees had an average of 0.4 million nosema spores indicating some level of pressure.
- Virus analysis showed elevated levels of Black Queen Cell Virus, Deformed Wing Virus, Sac Brood Virus and Israeli Acute Bee Paralysis Virus but results were not significantly different from average virus levels.
- Colonies contained between 8 and 15 frames of bees, indicating that an 800 to 1,000 dead bee threshold would be used as guidance to indicate an acute pesticide poisoning. Colonies had sustained an estimated population loss of ≈68 to 270 dead bees in and around hive entrances.
- Colonies had a brood pattern of 3.

Pesticide Investigation

- Apistan Strips (fluvalinate) were used in the fall of 2014 for varroa mite control, but no miticides were used in 2015 for purposes of apiary health.
- Pesticide analysis were carried out at MDA and USDA labs.
- MDA confirmed that most of the surrounding areas soybean fields were being sprayed, mainly by air, using a variety of insecticides and by multiple applicators.

Redwood County, Springfield **Inspection: KDR107000292**

Laboratory Results

Active Ingredient (Laboratory)	Quantified sample concentration (µg/kg)			
	Affected dead bees		Affected live bees	
	(% of acute contact benchmark)*			
Bifenthrin (MDA)**	88.6 (148%)	131.0 (218%)	20.7 (34.5%)	15.3 (25.5%)
Chlorpyrifos (MDA)**	66.9 (28.3%)	96.7 (41%)	19.0 (8.1%)	13.9 (5.9%)
Bifenthrin (USDA)	96.0 (160%)		21.8 (36.3%)	
Chlorpyrifos (USDA)	235.0 (99.6%)		No Detection	
Fluridone (USDA)	208.0 (0.0001%)		609.0 (0.0004%)	
Fluvalinate (USDA)	No Detection		2.6 (0.003%)	

* Benchmark = EPA's toxicity value x the Level of Concern (LOC). Where 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 is lower, and the LOC is 0.4. Laboratory results are divided by the benchmark and expressed as a percentage.

** Samples run twice, results from both analyses are shown.

Conclusion

- Degradation of the original exposure concentrations may have occurred due to light exposure and rain that occurred one day before the samples were collected.
- Bifenthrin and chlorpyrifos residues were detected at or above the acute contact benchmark in/on dead bees. Residues meeting EPA's LOC indicate a relatively high exposure which meets or exceeds 40% of an active ingredients LD_{50} value.
- Bee exposure to fluridone (an aquatic herbicide used to manage aquatic vegetation in fresh water bodies including drainage and irrigation canals) and fluvalinate (a registered in-hive miticide, used to treat *Varroa destructor* by beekeepers) were present in low concentrations and likely did not contribute to bee mortality.
- Due to the relatively high levels of bifenthrin and chlorpyrifos residue present on/in dead bees at the time of the investigation, and due to the high level of applicator activity in the surrounding area, it is likely that mortality observed by the beekeeper was due to insecticide exposure from direct or indirect contact.
- Because the MDA could not identify where bees were foraging at the time of the incident and because there were multiple applicators applying insecticides in the surrounding area, investigators were not able to identify a responsible party.
- Because of the low number of dead bees quantified in/around hives and because the beekeeper was not registered with Beecheck, they did not meet compensation requirements.
- When the case was closed, results were reported to the U.S.EPA.

Compensation **–** The beekeeper did not meet compensation requirements.

Terms and Definitions

Acute Pesticide Kill – Short term exposure to a bee toxic pesticide resulting in bee death. See page 2 for how the MDA evaluates an "acute pesticide poisoning" for purposes of compensation.

Aerial Application – Fixed wing (plane) or helicopter applications of pesticides. Pilots are required to be licensed by the FAA and the MDA.

Analyte – Samples collected during an investigation for pesticide residue analysis undergo a process to identify and measure chemical constituents. The specific chemicals being looked for during this process are considered analytes.

Bee Kill Complaint – The initial information received by the MDA by a complainant who believes that the death of their bees is due to pesticides.

Brood Pattern – The distribution of a queen's egg laying and immature bees in the frames of a hive. A greater concentration of brood, immature bees, indicates less brood disease, a healthier queen, and is correlated with a higher brood pattern score (1 to 5).

Colony – The collection of a queen and all offspring (foragers, nurse bees, and drones) who coinhabit an individual hive

Commercial Beekeeper – Beekeepers who have 100's to several 1,000 colonies. They are generally migratory and conduct pollination services for hire. Commercial beekeepers generally move their colonies out of Minnesota in winter and bring back in late April/early May each year.

Compensation – Hive owners may be compensated for "acute pesticide poisonings" under Minnesota state law.

Composite Sample – A sample consisting of like material collected from multiple sources. The analytical output obtained from a composite sample are considered representative results from the multiple, like sample sources.

Enforcement Action – The MDA issues both written warnings and financial penalties to persons who the MDA alleges violated state/federal pesticide law. Financial penalties are referred to as a "Notice of Intent to Sue".

EPA – Environmental Protection Agency. The federal agency that approves the registration of pesticides.

FIFRA – The Federal Insecticide Fungicide Rodenticide Act. Pesticides are only registered by EPA when there will be no unreasonable adverse effects from the legal use of the pesticide according to label instructions.

Frames of bees – An indirect measurement of the number of bees in a colony. Frames of bees can be estimated by the number of frames, in a brood box, that are completely covered with bees on both sides. The estimate is performed by looking at the top and bottom of a brood box and averaging the number of frames covered in bees together before multiplying by an average number of bees known to cover a frame, approximately 2,400.

Hive – The unit in which a honey bee colony lives. Often, beekeepers use a Langstroth hive consisting of stackable hive boxes that are filled with removable frames.

Hobby Beekeeper – Non-migratory beekeepers that may have a single hive or up to dozens of hives who keep bees primarily for honey, pollen and other bee products.

Lethal dose to 50% of a population (LD_{50}) – Amount of pesticide (the Lethal Dose) required to kill one-half (50%) of the test organisms (e.g., bees) in controlled studies. Findings of pesticide residues at less than the LD_{50} may contribute to the death of some, but less than half of the bees that have been exposed to the pesticide.

Level of Concern (LOC) – A value used to assess the risk of an environmental exposure. For honey bees, an EPA LOC of 0.4 is used to compare the acute contact or oral risk from exposure to a pesticide.

Limit of Detection (LOD) – The lowest concentration of an analyte that can be accurately detected by an analytical procedure.

Limit of Quantification (LOQ) – The lowest concentration of an analyte at which a measurement is quantitatively reliable.

Nosema spp. – A microsporidia, fungal, pathogen that infects the gut of honey bees resulting in accelerated behavioral development, alters feeding behavior, and can lead to other adverse effects.

Pesticide – A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. For compensation, a bee kill resulting from use of a bee toxic pesticide is considered an acute pesticide poisoning. There are General Use pesticides which do not require a license to apply and Restricted Use pesticides which may only be applied by a licensed/certified applicator.

Pesticide Applicator – The person who applies the pesticide. The MDA maintains databases of all licensed applicators in the state.

Pesticide Dealer – A business that has a license to sell pesticides.

Pesticide Label – Any text or images printed directly on, or attached to, the product or its packaging. Pesticide product labels provide critical information about how to safely handle and use pesticide products. Many insecticide products contain directions for use and prohibited uses when applying in areas where pollinators are present. Pesticide labels are legally enforceable under state law.

Seed Treatments – An insecticide, fungicide, or microbial treatment coating individual plant seeds to protect them against pests or impart other characteristics. A significant number of crop seeds are treated with insecticides/ or fungicides. Under FIFRA, seeds treated with pesticides are considered treated articles.

Treated Articles – An article or substance treated with, or containing, a pesticide to protect the treated article or substance itself if the pesticide is registered for such use. Articles that fall into this categorization, such as pesticide treated seeds, are exempt from all requirements of FIFRA.

Varroa destructor – A common parasitic mite of the honey bee. High numbers result in reduced vigor of honeybees/colony health. Many beekeepers treat their colonies one to four times per year for varroa mite.

Virus – An agent that causes infectious disease. Honey bees can be infected by a variety of viruses including 7 of which are analyzed for during MDA investigations.

A Note on Public Data

State government data is presumed to be “public” unless a statute, federal law, or temporary classification specifically classifieds the data as “not public” or otherwise restricts the use or disclosure to the data. MDA’s investigation files usually include public and protected information. To request a copy of the public information contained in an MDA investigation, contact the Pesticide and Fertilizer Management Data Practices Coordinator by phone: 651-201-6698; email: Chelsie.kolnik@state.mn.us, or fax: 651-201-6112.

MDA Pesticide Analyte List Used in Bee Kill Investigations

#	Analyte	Limit of Detection (ppb)*
1	3-OH Carbofuran	0.2
2	5-hydroxy Imidacloprid	0.4
3	6-Chloronicotinic acid**	N/A
4	Abamectin	0.4
5	Acephate	0.3
6	Acetamiprid	0.04
7	Acetochlor	5
8	Alachlor	5
9	Aldicarb	0.3
10	Aldicarb Sulfone	0.3
11	Aldicarb Sulfoxide	0.3
12	Allethrin	25
13	Amitraz**	5
14	Amit-Met DMPMF	25
15	Amitraz Metab DMPF	0.4
16	Atrazine	5
17	Azinphos	5
18	Bendiocarb	0.04
19	Bifenazate	0.4
20	Bifenthrin	15
21	Bromophos**	N/A
22	Carbaryl	0.3
23	Carbofuran	0.2
24	Chlorantraniliprole	0.4
25	Chlorfenvinphos	5
26	Chlorpyrifos	5
27	Chlorthalonil	5
28	Clofentezine	0.3
29	Clomazone	5
30	Clothianidin	0.04
31	Coumaphos	2
32	Cyanazine	5
33	Cyfluthrin	15
34	Cyhalothrin	5
35	Cypermethrin	10
36	Cyphenothrin	15
37	Deltamethrin/Traloemthrin	15
38	Desethylatrazine	5
39	Desisopropylatrazine	10
40	Diazinon	10
41	Dichlorvos	5
42	Dimethenamid	50
43	Dinotefuran	0.04
44	Dinotefuran DN 1	0.2
45	Dinotefuran UF**	N/A

MDA Pesticide Analyte List Used in Bee Kill Investigations

#	Analyte	Limit of Detection (ppb)*
46	Emamectin benzoate	0.04
47	EPTC	5.0
48	Esfenvalerate	15
49	Ethafluralin	5.0
50	Etofenprox (NH4)	0.04
51	Etoxazole	0.04
52	Fenpropathrin	15
53	Fenthion	5.0
54	Fipronil	5.0
55	Flubendamide	2.0
56	Flumethrin	15
57	Fluvalinate (tau)	10
58	Fonofos	5.0
59	Formatamate	1.2
60	Imidacloprid	0.04
61	Imidacloprid des nitro olefin	0.04
62	Imidacloprid HCl desnitro	0.05
63	Imidacloprid olefin	1.2
64	Imidacloprid urea	0.04
65	Imiprothrin**	N/A
66	Malathion	30
67	Metazachlor	5.0
68	Methamidophos	20
69	Methidathion	5.0
70	Methiocarb	0.2
71	Methomyl	0.3
72	Methyl Parathion	10
73	Metofluthrin**	N/A
74	Metolachlor	10
75	Metolcarb	0.3
76	Metribuzin	5.0
77	Mevinphos	5.0
78	Monocrotophos	10
79	Nithiazine	0.3
80	Oxamyl	0.3
81	Parallethrin**	N/A
82	Pendimethalin	10
83	Permethrin cis-, trans	5.0
84	Phenothrin	15
85	Phorate	5.0
86	Phosmet	5.0
87	Phosphamidon	20
88	Pirimiphos-me, et	5.0
89	Prometon	5.0
90	Propachlor	5.0

MDA Pesticide Analyte List Used in Bee Kill Investigations

#	Analyte	Limit of Detection (ppb)*
91	Propazine	10
92	Propoxur	0.04
93	Resmethrin	15
94	Simazine	50
95	Spinetoram J	0.4
96	Spinetoram L	2.0
97	Spinosad A	0.3
98	Spinosad D	0.4
99	Spirodiclofen	1.2
100	Spiromesifen	0.4
101	Spirotetramat	0.4
102	Strychnine	5.0
103	Sulfotep**	N/A
104	Tefluthrin	15
105	Terbufos	5.0
106	Tetramethrin	15
107	Thiacloprid	1.2
108	Thiamethoxam	0.04
109	Thiodicarb	0.3
110	Triallate	5.0
111	Triflumuron	0.3
112	Trifluralin	5.0
113	Vinclozolin	10
114	Pyrethrins	50

* Detection limit can be lower depending on water content of sample

** Can be looked for upon request

N/A – Analytes have poor recovery and require special calibration of equipment

USDA Pesticide Analyte List Used in Bee Kill Investigations

#	Analyte	Limit of Detection (ppb)
1	1-Naphthol	10
2	2,4 Dimethylaniline	50
3	2,4 Dimethylphenyl formamide (DMPF)	10
4	3-Hydroxycarbofuran	10
5	4,4 dibromobenzophenone	4.0
6	Acephate	50
7	Acetamiprid	2.0
8	Acetochlor	50
9	Alachlor	10
10	Aldicarb	4.0
11	Aldicarb sulfone	2.0
12	Aldicarb sulfoxide	20
13	Aldrin	10
14	Allethrin	10
15	Amicarbazone	30
16	Amitraz	4.0
17	Atrazine	6.0
18	Azinphos methyl	6.0
19	Azoxystrobin	2.0
20	Bendiocarb	10
21	Benoxacor	20
22	BHC alpha	4.0
23	Bifenazate	20
24	Bifenthrin	2.0
25	Boscalid	4.0
26	Bromuconazole	20
27	Buprofezin	20
28	Captan	10
29	Carbaryl	30
30	Carbendazim (MBC)	5.0
31	Carbofuran	10
32	Carboxin	4.0
33	Carfentrazone ethyl	1.0
34	Chlorfenopyr	1.0
35	Chlorfenvinphos	6.0
36	Chlorferone	50
37	Chlorothalonil	30
38	Chlorpropham (CIPC)	40
39	Chlorpyrifos	1.0
40	Chlorpyrifos methyl	1.0
41	Clofentezine	100
42	Clothianidin	1.0
43	Coumaphos	5.0
44	Coumaphos oxon	5.0
45	Cyfluthrin	4.0

USDA Pesticide Analyte List Used in Bee Kill Investigations

#	Analyte	Limit of Detection (ppb)
46	Cyhalothrin total	1.0
47	Cypermethrin	4.0
48	Cyphenothrin	20
49	Cyprodinil	1.0
50	DOD p,p'	4.0
51	ODE p,p'	2.0
52	DDT p,p'	4.0
53	Deltamethrin	50
54	Diazinon	5.0
55	Dichlorvos (DDVP)	50
56	Dicloran	1.0
57	Dicofol	1.0
58	Dieldrin	10
59	Difenoconazole	10
60	Diflubenzuron	10
61	Dimethenamid	10
62	Dimethoate	50
63	Dimethomorph	20
64	Dinotefuran	2.0
65	Diphenamid	20
66	Endosulfan I	2.0
67	Endosulfan II	2.0
68	Endosulfan sulfate	2.0
69	Endrin	10
70	Epoxiconazole	1.0
71	Esfenvalerate	2.0
72	Ethion	10
73	Ethofumesate	10
74	Etoxazole	1.0
75	Etridiazole	50
76	Famoxadone	20
77	Fenamidone	10
78	Fenbuconazole	10
79	Fenhexamid	6.0
80	Fenoxaprop-ethyl	20
81	Fenpropathrin	10
82	Fenpyroximate	5.0
83	Fenthion	10
84	Fipronil	10
85	Flonicamid	8.0
86	Flubendiamide	25.0
87	Fludioxonil	20
88	Fluoxastrobin	4.0
89	Fluridone	10
90	Flutolanil	4.0

USDA Pesticide Analyte List Used in Bee Kill Investigations

#	Analyte	Limit of Detection (ppb)
91	Fluvalinate	1.0
92	Heptachlor	4.0
93	Heptachlor epoxide	10
94	Hexachlorobenzene (HCB)	1.0
95	Hexythiazox	30
96	Hydroprene	20
97	Hydroxychlorothalonil	50
98	Imazalil	20
99	Imidacloprid	1.0
100	Imidacloprid 5-hydroxy	25
101	Imidacloprid olefin	10
102	Indoxacarb	3.0
103	Iprodione	50
104	Lindane	4.0
105	Linuron	20
106	Malathion	4.0
107	Metalaxyl	2.0
108	Methamidophos	4.0
109	Methidathion	10
110	Methomyl	10
111	Methoxyfenozide	10
112	Metolachlor	6.0
113	Metribuzin	1.0
114	MGK-264	50
115	MGK-326	10
116	Myclobutanil	15
117	Norflurazon	6.0
118	Oxamyl	5.0
119	Oxyfluorfen	1.0
120	Paradichlorobenzene	10
121	Parathion methyl	2.0
122	Pendimethalin	6.0
123	Permethrin total	10
124	Phenothrin	10
125	Phorate	50
126	Phosalone	10
127	Phosmet	10
128	Piperonyl butoxide	50
129	Pirimiphos methyl	20
130	Prallethrin	4.0
131	Profenofos	10
132	Pronamide	1.0
133	Propachlor	10
134	Propanil	10
135	Propargite	10

USDA Pesticide Analyte List Used in Bee Kill Investigations

#	Analyte	Limit of Detection (ppb)
136	Propazine	20
137	Propetamphos	4.0
138	Propham	20
139	Propiconazole	20
140	Pymetrozine	20
141	Pyraclostrobin	15
142	Pyrethrins	50
143	Pyridaben	10
144	Pyrimethanil	20
145	Pyriproxyfen	10
146	Quinoxyfen	10
147	Quintozene (PCNB)	1.0
148	Resmethrin total	5.0
149	Sethoxydim	2.0
150	Simazine	50
151	Spinosad	50
152	Spirodiclofen	2.0
153	Spiromesifen	10
154	Tebuconazole	8.0
155	Tebufenozide	10
156	Tebuthiuron	2.0
157	Tefluthrin	1.0
158	Tetrachlorvinphos	4.0
159	Tetraconazole	6.0
160	Tetradifon	1.0
161	Tetramethrin	10
162	Thiabendazole	1.0
163	Thiacloprid	1.0
164	Thiamethoxam	1.0
165	THPI	50
166	Thymol	50
167	Triadimefon	2.0
168	Triadimenol	45
169	Tribufos (DEF)	2.0
170	Trifloxystrobin	1.0
171	Triflumizole	50
172	Trifluralin	1.0
173	Triticonazole	10
174	Vinclozolin	1.0