

Minnesota Hazardous Substances Emergency Events Surveillance

Pesticide Incidents in Minnesota, 1995-2008

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Contents

	Page
List of Tables	iii
List of Figures	iv
Executive Summary	1
Introduction	2
Methods	2
Results	3
Overview	3
Top pesticides reported	3
Geographic distribution	4
Incident type	4
Factors	4
Category of the incident	4
Victims	4
Discussion	5
Limitations	6
Conclusion	6
References	6

List of Tables

- Table 1. Pesticide events per year, 1998-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 2. Pesticide events by month, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 3. Top five individual pesticides involved in incidents, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 4. Detailed factors in releases of pesticides, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 5. Category of pesticide incidents, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 6. Pesticide incidents with victims, by year, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 7. Top three symptoms related to pesticide incidents, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 8. Top pesticide spill or air releases resulting in injuries (excluding trauma injuries from vehicle crashes), 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Table 9. Demographics of pesticide incident victims, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

* preliminary 2008 data

List of Figures

- Figure 1. Pesticide incidents by year, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Figure 2. Pesticides incidents, by month, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Figure 3. Pesticide incidents with victims, by month, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance
- Figure 4. Acute HSEES pesticide incidents in Minnesota, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

* preliminary 2008 data

EXECUTIVE SUMMARY

The Hazardous Substances Emergency Events Surveillance (HSEES) system, maintained by the Agency for Toxic Substances and Disease Registry (ATSDR), collects information to describe the public health consequences of acute releases of hazardous substances in participating states. This report summarizes pesticide spills or air release incidents reported in Minnesota from 1995-2008*. Information collected about acute incidents involving hazardous substances includes the substance(s) and quantity involved; time, place, and cause of the incident; number of victims and injuries sustained; response; and public health protective actions taken.

A total of 634 events were reported, with 45 victim events and 68 victims. The majority (62.6%) of incidents were related to agriculture, though about 21% were related to turf and ornamentals. Pesticides most frequently reported were pendimethalin, glyphosate, trifluralin, and acetochlor. Common causes of incidents were problems during transportation and problems with valves and hoses. The most incidents occurred in May (33.4%), with a high number in other spring and summer months as well. About 79% of victims were male and about 74% were employees. The most common symptoms experienced by victims were trauma and respiratory irritation.

Better training on specific pieces of equipment and better preparation before transport may help in reducing the number of incidents.

* preliminary 2008 data

A summary of pesticide incidents in Minnesota, 1995-2008

Minnesota Hazardous Substances Emergency Events Surveillance
Minnesota Department of Health

Introduction

According to the National Agricultural Statistics Service, 53% of the land area in Minnesota is used for farming (1), with about 21.5 million acres of agricultural land treated with pesticides in 2007 (2). In addition, pesticides are used for lawn care, ornamental plants, home gardens, indoor pest control, mosquito control, and other applications. In most storage, handling, and application activities involving these pesticides, there is potential for accidental or illegal spill or air release.

The Hazardous Substances Emergency Events Surveillance (HSEES) system, sponsored by the federal Agency for Toxic Substances and Disease Registry (ATSDR), collects information about acute unplanned and illegal releases of hazardous substances and the resulting acute public health effects. For the past 14 years, the Minnesota Department of Health has been collecting information about pesticide incidents through the HSEES system. The information in this summary was collected during 1995-2008. More information about HSEES can be found at <http://www.health.state.mn.us/divs/eh/hazardous/surv/index.html>

Methods

For HSEES, a substance is considered hazardous if it could cause a human health effect. Spills or air releases are included in HSEES if the quantity is 10 pounds or 1 gallon or more, or if ATSDR has mandated the substance be included at any quantity released. Incidents that involve a potential, but not actual, spill or air release of a hazardous substance are included if the release threat resulted in a public health action, such as an evacuation or a shelter-in-place order.

Information on hazardous substance incidents is initially collected from the Minnesota Duty Officer, the National Response Center, the U.S. Department of Transportation Hazardous Materials Incident Reporting System, media reports, responders, businesses or other sources. If the reported incident appears to meet the HSEES case definition, a record is created in the online HSEES database. Further information about the incident is then gathered by contacting, when possible, scene responders, the responsible party or parties, local government units, and others with knowledge about the incident. If the incident continues to meet HSEES case definition, the record is coded "surveillance = yes" and the record is included in the HSEES data set. If the incident does not meet the HSEES case definition, the record is coded "surveillance = no" and the record is excluded from the HSEES data set.

Examples of data collected for HSEES are: type and quantity of substance involved; factors contributing to the incident; transportation status, if any, at the time of the incident; response actions, such as evacuation, shelter-in-place orders, and attempts to stop or control the spill or air release; responders that came to the scene (e.g., fire

department, company response team) and time frame of the event. Additionally, information about the area surroundings and conditions at the time of the spill, such as weather, surrounding population, facilities, and general land use, is collected.

Victims are defined as anyone that experiences an adverse health effect related to the incident within 24 hours of the spill or air release. When possible, information about the victim's category (e.g., employee, general public, responder, etc.), general symptoms, age, sex, distance from the incident site, general extent of treatment needed, and decontamination status is collected.

For this summary, pesticide incidents related to agriculture, turf and ornamental plants, home gardening, mosquito control or transportation were included. Water treatment chemicals, sanitizers, and sterilizers designed to control microbial growth in water or in indoor environments were not included. This summary includes mixtures of pesticides and fertilizers, but excludes incidents involving fertilizers only. To gain additional information about the incident, information was extracted from the comments in each record, when available. The general cause of the incident, such as problems with hoses, valves, or storage containers, was identified, sorted, and tabulated.

Results

Overview

During 1995-2008, there were 634 incidents involving a pesticide, with an average of 45 (median 46) incidents per year (Table 1). The year with the most reported HSEES pesticide incidents was 1997 (70, 11.0%), while the year with the least was 2006 (20, 3.2%). Overall, there has been a downward trend in incidents reported (Figure 1). It is not known if this is because there have been fewer incidents or a decrease in reporting.

The most pesticide incidents occurred in April (69, 10.9%), May (212, 33.4%), June (153, 24.1%) and July (81, 12.8%) (Figure 2, Table 2). The most pesticide incidents that resulted in victims occurred in May (12, 26.7%), June (6, 13.3%), July (7, 15.6%), and August (8, 17.8%) (Figure 3). These spring and summer months coincide with the growing season in Minnesota.

Top pesticides reported

More than one pesticide could be involved in an incident. There were 870 chemicals spilled or released to the air in the 634 incidents involving at least one pesticide. However, not all 870 chemicals were pesticides. For example, large chemical storage facility fires involved several types of chemicals in one event. Of the chemicals reported, 747 (85.9%) were classified as pesticides for this summary.

Most incidents (582, 91.8%) involved only one chemical. The pesticides most frequently spilled or released to the air were pendimethalin, glyphosate, trifluralin, acetochlor, and pesticides not otherwise specified (NOS) (Table 3). There were 220 (34.7%) incidents involving pesticide mixtures or pesticide/fertilizer mixtures. These mixtures were

composed of a wide variety of substances. The most commonly reported mixtures contained atrazine and dicamba (6 releases) and Lesco and Trimec (6 releases).

Geographic distribution

The majority of pesticide incidents (439, 69.2%) outside of the seven county Twin Cities Metropolitan Area occurred in the southern and western portion of the state (west of the Mississippi River), where a substantial amount of crop agricultural activity occurs. Pesticide incidents recorded in the Twin Cities Metropolitan Area (160, 25.2%) were often related to lawn care and home gardening (96, 60.0%). No pesticide incidents were reported to HSEES for Clearwater, Cook, Crow Wing, Kanabec, and Lake counties (Figure 4).

Incident type

There were 264 (41.6%) pesticide incidents that occurred at a fixed facility, while 370 (58.4%) pesticide incidents involved transportation. Many of the transportation incidents involved vehicle crashes and rollovers.

For comparison, in all 5,761 Minnesota HSEES records, there were 4,217 (73.2%) incidents that occurred at a fixed facility and 1,544 (26.8%) incidents that occurred during transportation.

Factors

Each HSEES record has a field for recording the general factor(s) contributing to the incident, such as human error, equipment failure, weather disaster, or illegal act. The general factor is selected after examining information about the incident. An analysis of these fields for pesticide incidents showed that the most frequently reported factor was human error (239 incidents, 37.7%). Equipment failure was the second-most frequently reported primary factor, occurring in 169 (26.7%) incidents.

More detailed cause of the incident was determined by reviewing each record's comment field. This review showed the most common factors in pesticides incidents were: problems during transport (e.g., container fell from vehicle, vehicle crash); problems with hoses and lines (e.g., hose ruptured, hose disconnected); and valve problems (e.g., valve turned wrong way, valve malfunction). A full list of categorized causes is in Table 4.

Category of the incident

The majority (397, 62.6%) of the pesticide incidents was related to agricultural application. Turf and ornamental pesticide application also represented several incidents (131, 20.7%). Public administration (23, 3.6%), which includes maintenance of right-of-ways and park maintenance, and transportation, warehousing, and wholesale (20, 3.2%) also represented several incidents. The distribution of the categories is shown in Table 5.

Victims

There were 68 victims resulting from pesticide incidents. The number of victims by year is shown in Table 6. Although all of the victims received injuries that occurred in conjunction with a pesticide incident, injuries sustained by 35 victims were trauma

injuries that occurred in vehicle crashes or rollovers (Table 7). These injuries occurred concurrently with the pesticide incident but were not directly caused by the pesticide. The incidents producing the most victims without trauma injuries are shown in Table 8.

The majority of the victims were male (54, 79.4%). The most severe injury for males was death from trauma resulting from vehicle crashes (2 victims). The most severe injury for females was hospitalization for trauma after vehicle crashes.

Most victims were employees (50, 73.5%). Of the employee victims, 45 (90.0%) were male and four (8.0%) were female. Data for the sex of one (2.0%) employee was not reported. There were 16 victims (23.5%) in the general public category, with eight (50.0%) males, seven (43.8%) females and the sex of one (6.3%) was not reported. Two responder victims were reported: one (50.0%) male and one (50.0%) female.

Victim ages ranged from 1 to 76 years. Nearly half (33, 48.5%) of the victims were in the 20-44 age category with 15 (22.1%) in the 45-64 age category (Table 9).

Discussion

The most frequently reported type of pesticide spilled was herbicide used on crop fields, reflecting the large agricultural industry in the state. Many of these incidents were related to human error, especially errors in transportation, errors with valves, and problems with lines and hoses. When compared to all MN HSEES incidents, pesticide incidents had a higher percentage related to transportation, including vehicle crashes, rollovers, or loss of containers or hoses from a vehicle.

Because many agricultural activities must often be done under certain weather conditions at a particular time of year, agricultural tasks must often be performed very quickly in a limited time frame. Spills or air releases of pesticides can result in substantial losses of time, product, and money, as well as increasing potential for human injury, damage to the environment, and the possibility of regulatory enforcement.

To reduce the likelihood of pesticide incidents, sufficient planning is imperative. For example, providing adequate training on specific pieces of application equipment, in addition to clearly labeling valves and other equipment components, could help reduce incidents. Thorough equipment inspections before the season begins could help reduce equipment failures that occur in the midst of application. Procedures that ensure rapid, secure, and reliable fastening of tanks, containers, and hoses for transport should be developed.

While agricultural and turf and ornamental plant-related pesticide spills were prominent in the MN HSEES incidents, there were no reports related to structural applications (e.g., building pest extermination). In 2001, a pesticide summary written by the MN HSEES program also noted that pesticide incidents related to structural applications were not found in the HSEES data and therefore did not appear to be reported to the Minnesota Duty Officer (3). This appears to have remained true for years subsequent to the 2001

report. It is not known if pesticide incidents related to structural application are very infrequent or if these incidents are not being reported.

Previous analyses of HSEES incidents have shown that males and employees are populations most frequently experiencing adverse health effects from hazardous substances incidents (4, 5). A similar pattern was found in the analysis of MN HSEES pesticide incidents, though the percentage of males was even higher in these records. This might reflect a high proportion of males working in pesticide application.

The two responder victims were law enforcement personnel. One experienced severe respiratory and nervous system symptoms while investigating a trail of spilled pesticide along a road. Another experienced respiratory irritation while assisting at a fire involving pesticides. Both of these cases emphasize the need for responders to use caution when working at scenes where pesticides could be involved, for use of personal protective equipment (PPE), and for summoning other responders equipped with PPE.

Limitations

It is not known how many unplanned or illegal spills or air releases of pesticides occur that are not reported, and therefore it is not known how accurately the collected data reflect the true number of pesticide incidents and associated injuries. In addition, some incidents reported through these notification sources were excluded from HSEES because the minimum quantity of 10 pounds or one gallon was not met.

Conclusion

Agricultural incidents are a substantial portion of the hazardous substance spills and air releases captured by the MN HSEES system. These incidents can cost time, money, product, and are a potential threat to human health and the environment. While it is unlikely that all incidents can be eliminated, those related to inadequately secured containers and hoses during transport, as well as those related to incorrect operation of equipment, might be reduced with better design of equipment and better training. The HSEES system will continue to collect and analyze data on hazardous substances incidents, raise awareness of trends, and support efforts to reduce spills and air releases and associated injuries.

References

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- 2) National Agricultural Statistics Service. (2007). Census of Agriculture, Fertilizers and Chemicals Applied: 2007 and 2002, Minnesota Statistics, 2009, Table 45. Accessed on April 21, 2009 from http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/Minnesota/st27_1_044_045.pdf

3) Minnesota Department of Health. (2002). Minnesota Hazardous Substances Emergency Events Surveillance, pesticide summary (unpublished).

4) Minnesota Department of Health. (2007). Hazardous Substances Emergency Events Surveillance, 1995-2006. Accessed on April 21, 2009 from <http://www.health.state.mn.us/divs/eh/hazardous/surv/hseesrpt9506.pdf>.

5) Agency for Toxic Substances and Disease Registry. (2006). Annual Report 2005. Accessed on April 21, 2009 from <http://www.atsdr.cdc.gov//HS/HSEES/annual2005.html>.

Table 1 – Pesticide incidents by year, 1995-2008*
 Minnesota Hazardous Substances Emergency Events Surveillance

Year	Number of HSEES pesticide incidents	Total HSEES incidents	Percent of total HSEES incidents (%)	Number of individual pesticides involved
1995	53	229	23.1	78**
1996	60	301	19.9	68
1997	70	265	26.4	77
1998	59	377	15.6	64
1999	52	348	14.9	55
2000	37	419	8.8	40
2001	57	414	13.8	92**
2002	44	354	12.4	44
2003	48	438	11.0	55
2004	33	468	7.1	43**
2005	37	407	9.1	37
2006	20	546	3.7	21
2007	35	595	5.9	43
2008*	29	600	4.8	30
Totals	634	5761	11.0	747
* preliminary 2008 data				
** includes a chemical warehouse fire				

Table 2. – Pesticide incidents by month, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

Month	Number	%
January	7	1.1
February	7	1.1
March	11	1.7
April	69	10.9
May	212	33.4
June	153	24.1
July	81	12.8
August	40	6.3
September	21	3.3
October	20	3.2
November	11	1.7
December	2	0.3
Total**	634	99.9

* preliminary 2008 data

** Total percent does not sum to 100 because of rounding.

Table 3. – Top five individual pesticides involved in incidents, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

Substance	Number of incidents
Pendimethalin	52
Glyphosate	51
Trifluralin	34
Acetochlor	27
Pesticide NOS**	25

* preliminary 2008 data

** NOS = not otherwise specified

**Table 4. – Detailed factors in pesticides incidents, 1995-2008
Minnesota Hazardous Substances Emergency Events Surveillance**

Transport		Tanks or containers	
<i>Inadequately secured items</i>		Tank/container ruptured/broke	24
Container fell from truck or vehicle	56	Tank or container leaking	21
Container fell from forklift	9	Container damaged	13
Container fell from sprayer	1	Overfill	12
Load shifted	1	Tank overturned/tipped in truck or field	11
Subtotal	67	Tank/container punctured	8
<i>Moving vehicle incidents</i>		Tanks or containers total	89
Aerial applicator crash	36	Valves or closures	
Vehicle rollover	31	Wrong valve (e.g., opened wrong valve)	39
Sprayer rollover	29	valve opened (e.g., valve came open)	26
Vehicle crash	18	valve malfunction	15
Other vehicle incidents	9	valve broken/damaged	10
Subtotal	123	valve (unspecified)	8
<i>Vehicle leaks (unspecified)</i>		Valves and closures total	98
Trucks (especially lawn care)	8	Fire/weather	
Aircraft	1	Fire	27
Subtotal	9	Tornado	2
Transport total	199	Flood	2
Hoses and Pipes		Fire/Weather total	31
<i>Hoses</i>		Illegal/Improper use	
hose ruptured or broke	47	Misapplication	9
hose disconnected	33	Improper disposal	8
hose fell (e.g., end of hose fell out of clamp on vehicle)	18	Vandalism	3
hose leaked	7	Illegal/Improper use	20
hose siphoned material from supply container	5	Miscellaneous	
Subtotal	110	Pumps	5
<i>Pipes</i>		Container fell from shelf	4
Pipe fitting leak	4	Inductors	3
pipe broke	2	Other	16
pipe leak	1	Miscellaneous total	28
Subtotal	7	Unknown	
Hoses and Pipes total	117	52	
		Total - all event factors	634

Table 5. – Category of release, pesticide incidents, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

Category	Number of events (%)
Agricultural	397 (62.6)
Turf and ornamentals	131 (20.7)
Other	46 (7.3)
Public Administration (right-of-ways)	23 (3.6)
Transportation/warehousing/ wholesale	20 (3.2)
Unknown	13 (2.1)
Mosquito control	4 (0.6)
Total	634

* preliminary 2008 data

Table 6. – Pesticide incidents with victims, by year, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

Year	Number pesticide incidents with victims	Number of victims	Number of all HSEES pesticide incidents	Percent of HSEES pesticide incidents with victims
1995	6	9	53	11.3
1996	4	4	60	6.7
1997	3	3	70	4.3
1998	2	2	59	3.4
1999	2	2	52	3.8
2000	3	13	37	8.1
2001	3	3	57	5.3
2002	3	3	44	6.8
2003	6	16	48	12.5
2004	3	3	33	9.1
2005	1	1	37	2.7
2006	2	2	20	10.0
2007	4	4	35	11.4
2008*	3	3	29	10.3
Totals	45	68	634	7.1

* preliminary 2008 data

Table 7. – Top three symptoms related to pesticide incidents, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

Symptoms	Number of victims with the symptom**
Trauma (usually resulting from vehicle crashes)	35
Respiratory Irritation	23
Eye Irritation	18

* preliminary 2008 data

** victims could have more than one symptom

Table 8. – Top pesticide spills or air releases resulting in injuries (excluding trauma injuries from vehicle crashes), 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

Substance/Incident(s)	Number of victims	Symptoms	Most severe outcome
Chloropicrin Improper disposal – released from a can at a recycling facility	11**	Respiratory irritation, eye irritation	Treated at a hospital and released
Dimethoate Two events: Spill at private residence; Fire at chemical warehouse	6	Respiratory irritation	Observation at hospital, no treatment
Pesticide (not otherwise specified) Two events: Improper disposal – released from a container at a recycling facility; fire at chemical warehouse	5	Respiratory irritation, eye irritation, gastrointestinal problems, and dizziness	Treated at a hospital and released
Methyl bromide (spill at private residence)	3**	Respiratory irritation and eye irritation	Treated on scene

* preliminary 2008 data

** all occurred in same incident

Table 9. Demographics of pesticide incident victims, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

	Total (n)		Sex					
		%	M	%	F	%	NA	%
Employees	50	73.5	45	83.3	4	33.3	1	50.0
General public	16	23.5	8	14.8	7	58.3	1	50.0
Responders	2	2.9	1	1.9	1	8.3	0	0.0
Total**	68	99.9	54	100.0	12	99.9	2	100.0
% of Total**			79.4		17.6		2.9	

	Age (years)										Total
	<20		20-44		45-64		>64		NA		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Employees	3	33.3	28	84.8	12	80.0	3	75.0	4	57.1	50
General public	6	66.7	3	9.1	3	20.0	1	25.0	3	42.9	16
Responders	0	0.0	2	6.1	0	0.0	0	0.0	0	0.0	2
Total**	9	100.0	33	100.0	15	100.0	4	100.0	7	100.0	68
% of Total**		13.2		48.5		22.1		5.8		10.3	

* preliminary 2008 data

** percentages might not sum to 100 because of rounding.

NA = Not available

Figure 1. Pesticide incidents by year, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

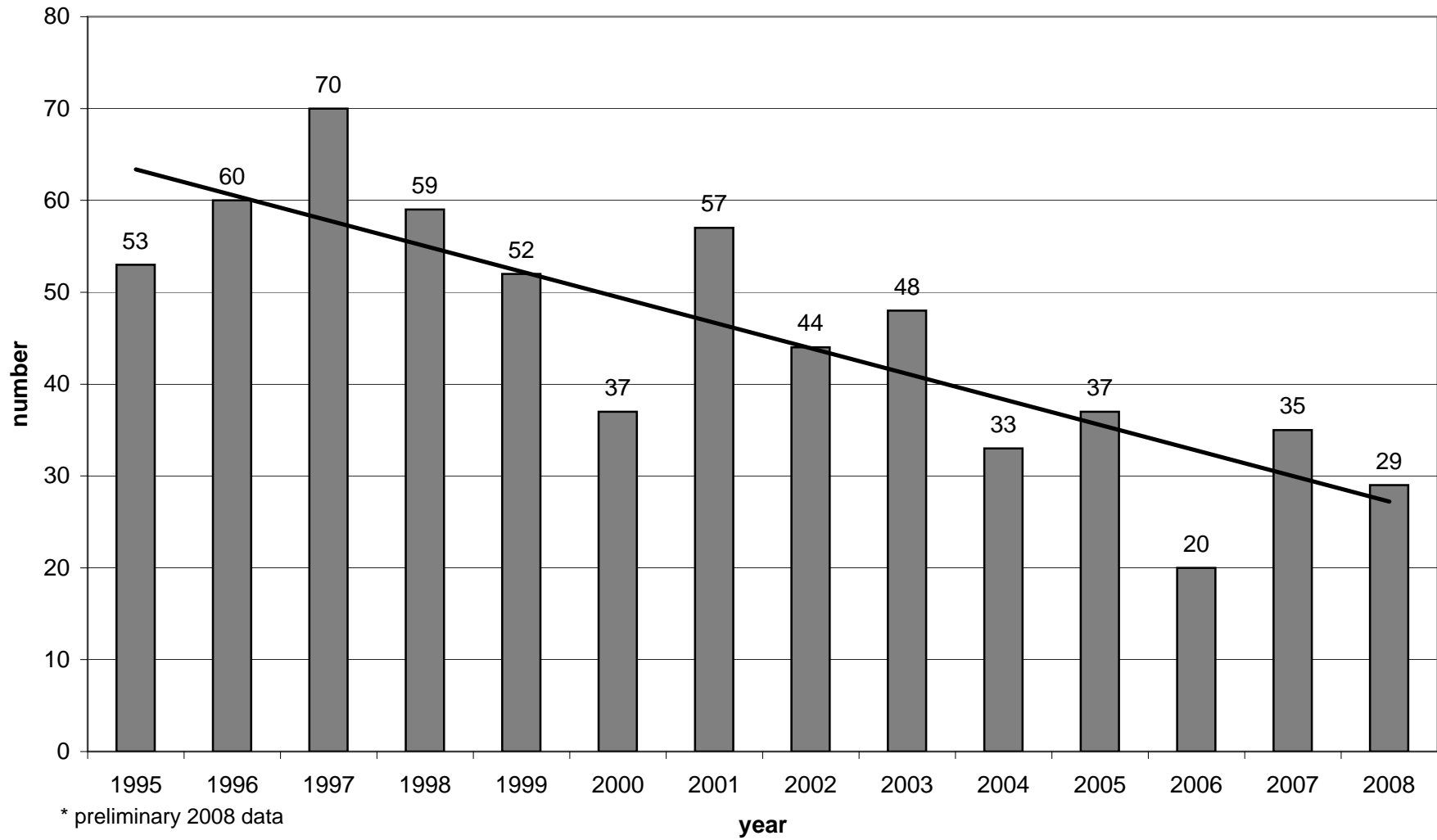


Figure 2. Pesticide incidents, by month, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

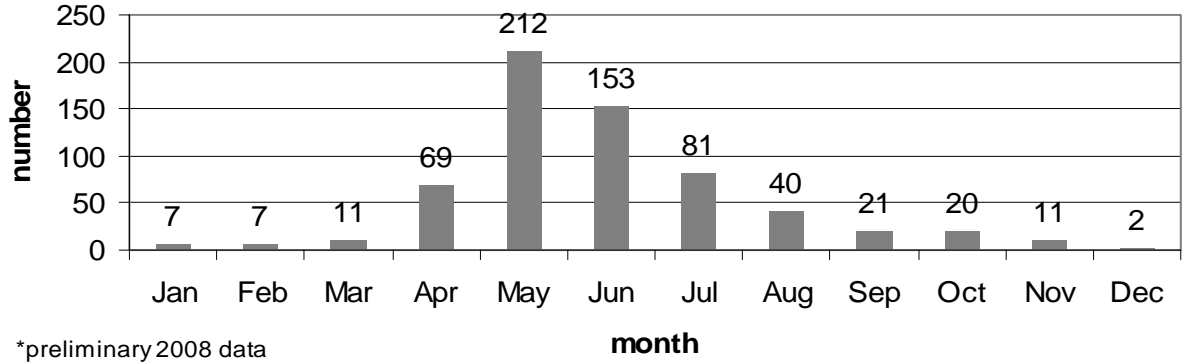


Figure 3. Pesticide incidents with victims, by month, 1995-2008*
Minnesota Hazardous Substances Emergency Events Surveillance

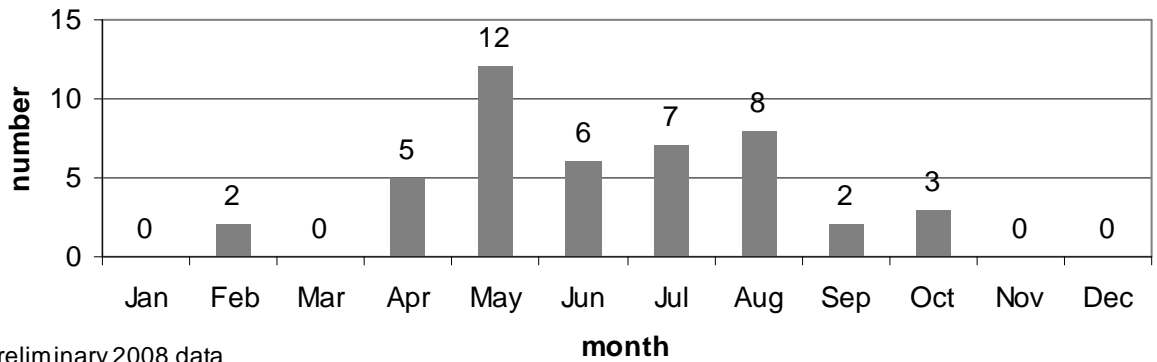
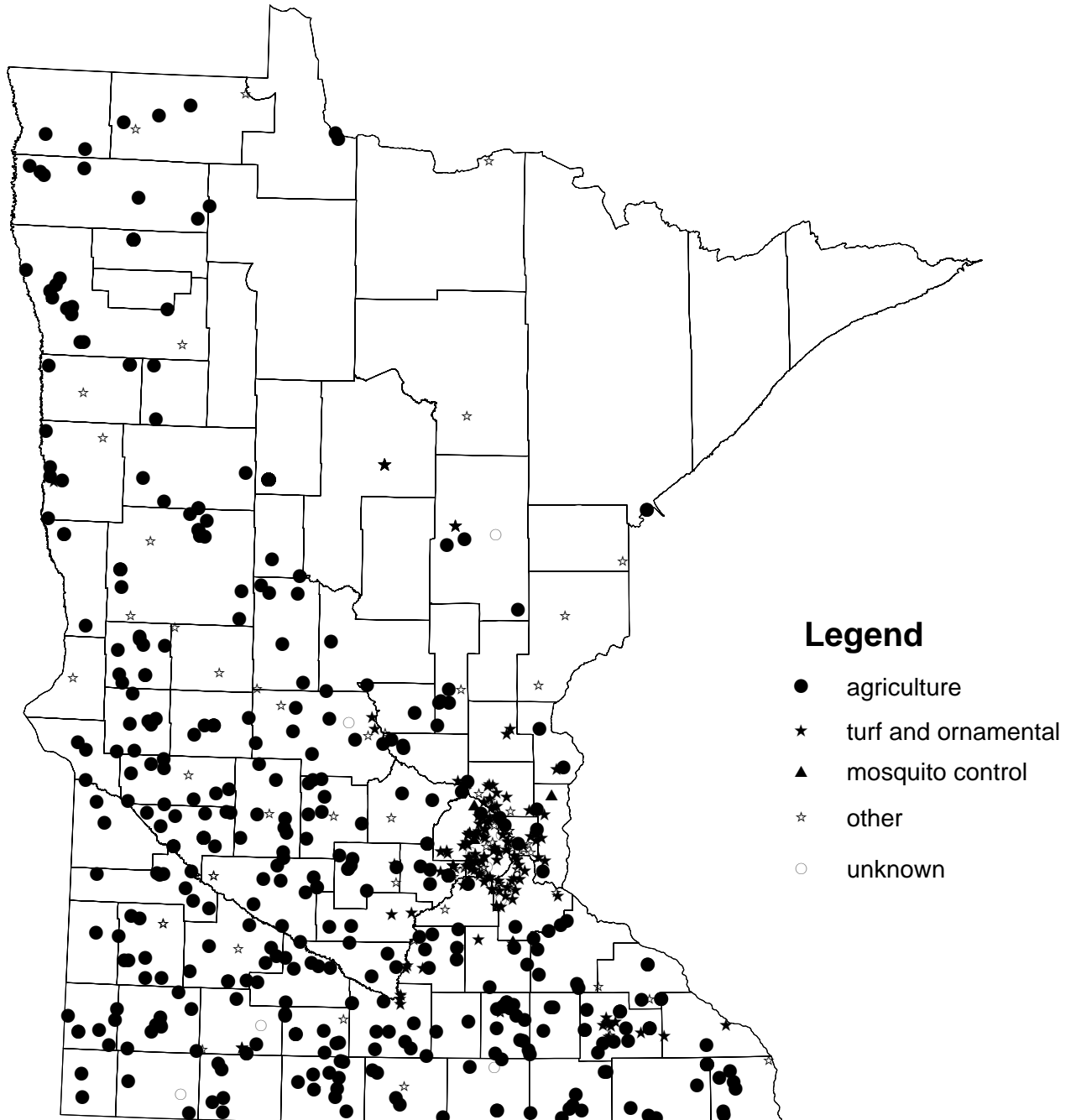


Figure 4. Acute HSEES pesticide incidents* in Minnesota, 1995-2008,**
Minnesota Hazardous Substances Emergency Events Surveillance



* Geocode not available for 60 events.

** Preliminary 2008 data.