UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Review of Esfenvalerate Incident Reports
DP Barcode D298034, Chemical #109303

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BACKGROUND

The following data bases have been consulted for the poisoning incident data on the active ingredient Esfenvalerate (PC Code: 109303):

1) OPP Incident Data System (IDS) - reports of incidents from various sources, including registrants, other federal and state health and environmental agencies and individual consumers, submitted to OPP since 1992. Reports submitted to the Incident Data System represent anecdotal reports or allegations only, unless otherwise stated. Typically no conclusions can be drawn implicating the pesticide as a cause of any of the reported health effects. Nevertheless, sometimes with enough cases and/or enough documentation risk mitigation measures may be suggested.

2) Poison Control Centers - as the result of a data purchase by EPA, OPP received Poison Control Center data covering the years 1993 through 1998 for all pesticides. Most of the national Poison Control Centers (PCCs) participate in a national data collection system, the Toxic Exposure Surveillance System which obtains data from about 65-70 centers at hospitals and universities. PCCs provide telephone consultation for individuals and health care providers on suspected poisonings, involving drugs, household products, pesticides, etc.

3) California Department of Pesticide Regulation - California has collected uniform data on suspected pesticide poisonings since 1982. Physicians are required, by statute, to report to their local health officer all occurrences of illness suspected of being related to exposure to pesticides. The majority of the incidents involve workers. Information on exposure (worker activity), type of illness (systemic, eye, skin, eye/skin and respiratory), likelihood of a causal relationship, and number of days off work and in the hospital are provided.

4) National Pesticide Telecommunications Network (NPTN) - NPTN is a toll-free information service supported by OPP. A ranking of the top 200 active ingredients for which telephone calls were received during calendar years 1984-1991, inclusive has been prepared. The total number of calls was tabulated for the categories human incidents, animal incidents, calls for information, and others.

ESFENVALERATE REVIEW

I. Incident Data System

The review of reports to the Incident Data System included only reports with an alleged major outcome. Those cases with minor or moderate outcome were excluded because the information was judged less-well documented and duplicative of reports from other sources reviewed below. Please note that the following cases from the IDS do not have documentation confirming exposure or health effects unless otherwise noted.

Incident#8768-3

A pesticide incident occurred in 1994, when an individual was hospitalized for an unknown number of days. Specific symptoms were not mentioned. No further information on the disposition of the case was reported.

Incident#8812-1

A pesticide incident occurred in 1994, when two individuals were hospitalized for an unknown number of days. Specific symptoms were not mentioned. No further information on the disposition of the case was reported.

Incident#12616-7

A pesticide incident occurred in 2001, when a seventy-eight year old man reported wheezing, coughing, and myalgia after using the product near a small door in the garage. No further information on the disposition of the case was reported.

Incident#12883-1

A pesticide incident occurred in 2002, when a pest control operator left a sprayer and bag unattended. As a result, a twenty-two month old boy soaked his clothes and was later taken to the hospital. The boy was treated by a physician and reported swollen fingers and difficulty breathing. Hydrocarbon aspiration was suspected. No further information on the disposition of the case was reported.

The last two reports above suggest that esfenvalerate can be a source of serious respiratory distress.

II. Poison Control Center Data - 1993 through 1998

Results for the years 1993 through 1998 are presented below for occupational cases, non-occupational involving adults and older children, and for children under age six. Cases involving exposures to multiple products and cases with unrelated medical outcome are excluded. Tables 1-4 present the hazard information for esfenvalerate compared with all other pesticides on six measures: percent with symptoms, percent with moderate, major, or fatal outcome, percent with major or fatal outcome, percent of exposed cases seen in a health care facility, and percent hospitalized and percent seen in a critical care facility. Table 1 reports the number of cases on which the data derived in Tables 2-4 are based. Table 2 presents this information for occupational cases, Table 3 for non-occupational cases involving adults and older children (six years or older), and Table 4 for children under age six.

Table 1. Number of esfenvalerate exposures reported to the Toxic Exposure Surveillance System (AAPCC), number with determined outcome, number seen in a health care facility for occupational and non-occupational cases (adults and children six years and older) and for children under six years of age only, 1993-1998 .

Subgroup	Exposures	Outcome determined	Seen in Health Care Facility
Occupational: adults and older children	32	20	16
Non-occupational: adults and older children	154	98	50
Children under age six	30	23	8

Table 2. Comparison between esfenvalerate and all pesticides for percent cases with symptomatic outcome (SYM), moderate or more severe outcome (MOD), life-threatening or fatal outcome (LIFE-TH), seen in a health care facility (HCF), hospitalized (HOSP), or seen in an intensive care unit (ICU) reported to Poison Control Centers, 1993-1998 for occupational cases only.

Pesticide	SYM*	MOD*	LIFE-TH*	HCF*	HOSP*	ICU*
Esfenvalerate	95.0%	15.0%	0%	50.0%	0.0%	0.0%
All Pesticides	86.0%	18.8%	0.621%	47.0%	6.08%	2.36%
Ratio	1.10	0.80	0.00	1.06	0.0	0.0

* Symptomatic cases based on those cases with a minor, moderate, major, or fatal medical outcome. Denominator for SYM, MOD, and LIFE-TH is the total cases where medical outcome was determined. Denominator for HCF is all exposures. Denominator for HOSP and ICU is all cases seen in a health care facility.

Table 3. Comparison between esfenvalerate and all pesticides for percent cases with symptomatic outcome (SYM), moderate or more severe outcome (MOD), life-threatening or fatal outcome (LIFE-TH), seen in a health care facility (HCF), hospitalized (HOSP), or seen in an intensive care unit (ICU) reported to Poison Control Centers, 1993-1998 for non-occupational cases involving adults and older children.

Pesticide	SYM*	MOD*	LIFE-TH*	HCF*	HOSP*	ICU*
Esfenvalerate	85.7%	27.6%	0.0%	32.5%	6.0%	2.0%
All Pesticides	68.5%	10.5%	0.359%	16.5%	6.24%	2.67%
Ratio	1.25	2.63	0.0	1.97	0.96	0.75

* Symptomatic cases based on those cases with a minor, moderate, major, or fatal medical outcome. Denominator for SYM, MOD, and LIFE-TH is the total cases where medical outcome was determined. Denominator for HCF is all exposures. Denominator for HOSP and ICU is all cases seen in a health care facility.

Table 4. Comparison between esfenvalerate and all pesticides for percent cases with symptomatic outcome (SYM), moderate or more severe outcome (MOD), life-threatening or fatal outcome (LIFE-TH), seen in a health care facility (HCF), hospitalized (HOSP), or seen in an intensive care unit (ICU) for adults and children six years and older reported to Poison Control Centers, 1993-1998 for children under six years old..

Pesticide	SYM*	MOD*	LIFE-TH*	HCF*	HOSP*	ICU*
Esfenvalerate	34.8%	8.70%	0%	26.7%	0.0%	0.0%
All Pesticides	21.8%	1.40%	0.120%	16.4%	4.78%	1.36%
Ratio	1.60	6.21	0.00	1.63	0.0	0.0

* Symptomatic cases based on those cases with a minor, moderate, major, or fatal medical outcome. Denominator for SYM, MOD, and LIFE-TH is the total cases where medical outcome was determined. Denominator for HCF is all exposures. Denominator for HOSP and ICU is all cases seen in a health care facility.

In general, esfenvalerate is more likely to cause minor to moderate symptoms than other pesticides, but much less likely to cause serious or major effects which would require hospitalization or critical care. Note that there were relatively few cases involving occupational exposure or children under age six. This means that one should be cautious about over-interpreting the results for these two groups. For example, the 6.2 increase in moderate symptoms among children under six years was based on only two cases. In all three groups, the most common symptoms were respiratory, gastro-intestinal, and neurological effects. By far, the most common moderate effects (almost always requiring medical attention) were difficulty breathing and cough in adults, suggesting that esfenvalerate may pose an asthma-like hazard.

An analysis was performed on the relative prevalence of reported symptoms to Poison Control Centers using the 1993-1998 data set. The percentage of exposed cases with symptoms for esfenvalerate was compared to the percentage of reported symptoms for all pyrethrin/pyrethroid insecticides. Based on 10 or more symptoms reported, esfenvalerate was 3.0 times more likely to report cough/choke (based on 30 reports), 3.8 times more likely to report difficulty breathing (based on 18 reports), and 10 times more likely to report chest pain (based on 15 reports). All three of these symptoms occurred 2-3 times more often (as a percentage of all exposures) for pyrethrins and pyrethroids than they did among non-insecticidal pesticides. Fenvalerate showed similar increases for cough and difficulty breathing, but not as much of an increase for chest pain. However, those exposed to fenvalerate had a four-fold increase in percent reporting bronchospasm compared to other pyrethrins and pyrethroids. This information supports the findings above suggesting that esfenvalerate may pose an increased risk for asthma-like symptoms.

III. California Data - 1982 through 2000

Detailed descriptions of 262 cases submitted to the California Pesticide Illness Surveillance Program (1982-2000) were reviewed. In 19 of these cases, esfenvalerate was used alone or was judged to be responsible for the health effects. Only cases with a definite, probable or possible relationship were reviewed. Esfenvalerate ranked 133rd as a cause of systemic poisoning in California based on data for 1982 through 1999. Table 1 presents the types of illnesses reported by year. Table 2 gives the total number of workers that took time off work as a result of their illness and how many were hospitalized and for how long.

Table 1. Cases Due to Esfenvalerate in California Reported by Type of Illness and Year, 1982-2000.

	Illness Type					
Year	Systemic[a]	Eye	Skin	Respiratory[b]	Combination[c]	Total
1982-9	-	-	-	-	-	-
1990	-	-	-	-	-	-
1991	1	-	1	-	-	2
1992	1	1	-	-	1	3
1993	-	-	-	-	-	-
1994	1	-	-	-	-	1
1995	-	-	-	-	-	-
1996	2	-	-	-	-	2
1997	2	1	-	2	-	5
1998	-	1	-	-	-	1
1999	-	-	-	-	-	-
2000	2	-	2	-	1	5
Total	9	3	3	2	2	19

[a] Category includes cases where skin, eye, or respiratory effects were also reported.
[b] Category not used until 1990. Prior respiratory cases classified as systemic.
[c] Category includes combined irritative effects to eye, skin, and respiratory system.

Table 2. Number of Persons Disabled (taking time off work) or Hospitalized for Indicated Number of Days After Esfenvalerate Exposure in California, 1982-2000.

Time period	Number of Persons Disabled	Number of Persons Hospitalized
One day	2	-
Two days	-	-
3-5 days	3	-
6-10 days	-	-
more than 10 days	-	-
Unknown	2	-

A variety of worker activities were associated with exposure to esfenvalerate as illustrated in Table 3 below.

Table 3. Illnesses by Activity Categories for Esfenvalerate Exposure in California, 1982-2000

Activity Category	Illness Category					
	Systemic[a]	Eye	Skin	Respiratory[b]	Combination[c]	Total
Applicator	1	2	1	-	1	5
Field Worker	2	-	1	-	-	3
Flagger	1	-	-	-	-	1
Manufacturing/ Formulation	-	1	-	-	-	1
Mixer/Loader	-	-	1	-	-	1
Other	1	-	-	-	-	1
Routine Indoor	2	-	-	2	-	4

Activity Category	Illness Category					
	Systemic[a]	Eye	Skin	Respiratory[b]	Combination[c]	Total
Routine Outdoor	2	-	-	-	1	3
Total	9	3	3	2	2	19

[a] Category includes cases where skin, eye, or respiratory effects were also reported.
[b] Category not used until 1990. Prior respiratory cases classified as systemic.
[c] Category includes combined irritative effects to eye, skin, and respiratory system.

According to the above activity categories, applicator was associated with more exposures than any other category. These illnesses included symptoms of conjunctiva, skin rashes, headache, dizziness, vomiting, nasal burning, and eye irritation. Effects to the eyes, skin, and respiratory tract seemed to predominate. One of the difficulties with the California data is that such a large percentage (93%) of cases involved mixtures where the predominate pesticide responsible for the illness was undetermined.

IV. National Pesticide Information Center

On the list of the top 200 chemicals for which NPIC received calls from 1984-1991 inclusively, esfenvalerate was ranked 155th with 18 incidents in humans reported and 3 in animals (mostly pets).

V. Scientific Literature

The following information is from http://ace.orst.edu/info/extoxnet/pips/esfenval.htm: EXTOXNET (Extension Toxicology Network) provides Pesticide Information Profiles. It is a Pesticide Information Project of Cooperative Extension Offices of Cornell University, Oregon State University, the University of Idaho, and the University of California at Davis and the Institute for Environmental Toxicology, Michigan State University. Major support and funding was provided by the USDA/Extension Service/National Agricultural Pesticide Impact Assessment Program. Comparing esfenvalerate with fenvalerate, EXTOXNET noted:

> Esfenvalerate has replaced the naturally occurring compound fenvalerate (to which it is almost identical) for use in the U.S. Much of the data for fenvalerate is applicable to the pesticide esfenvalerate because the two compounds contain the same components. The only differences in the two products are the relative proportions of the four separate constituents (isomers). Esfenvalerate has become the preferred compound because it requires lower applications rates than fenvalerate, is less chronically toxic, and is a more powerful insecticide. The compound contains a much higher percentage of the one insecticidally active isomer (84% for esfenvalerate and 22% for fenvalerate).

According to EXTOXNET:

> The bulk of evidence related to acute poisonings in humans due to esfenvalerate comes from incidents in India. Nearly 600 individual cases of poisoning were reported between 1982 and 1988. These cases were due to improper handling of the pesticide. Acute toxic effects were observed in workers and among the general public. Symptoms of acute poisoning included dizziness, burning and itching (which was worsened by sweating and washing). Severe cases of direct contact caused blurred vision, tightness in the chest, and convulsions (Ray 1991). The changes appear to be reversible. . . . The compound may produce nausea, vomiting, headache, temporary nervous system effects such as weakness, tremors, and incoordination at acute exposure levels in humans. Esfenvalerate is a strong eye irritant, producing tearing or blurring of vision.

Given the close relationship between esfenvalerate and fenvalerate the following summary from the World Health Organization's Environmental Health Criteria (1990) are provided for fenavalerate:

> Occupational exposure - Appraisal. Fenvalerate has been found to induce skin sensations in some of the workers who handle this insecticide. Clinical studies showed that the skin sensations develop with a latent period of approximately 30 min, peak by 8 h and deteriorate after 24 h. Numbness, itching, tingling, and burning are symptoms frequently reported

Flannigan et al. (1985) studied the effects of fenvalerate in a human assay involving topical application of milligram quantities to the ear. Subjects reported prominent paresthesia that was not seen when the same participants were exposed to the inert ingredients of this pyrethroid. An earlier study by Tucker and Flannigan (1983) reported that agricultural workers in Mississippi and Alabama had reported occasional cutaneous sensations from exposure to fenvalerate. including stinging, burning, and numbness in approximately one-third of workers. Areas around the face and hands were most often affected and perspiration, sun, heat, and water were reported to be exacerbating factors.

VI. Conclusions

Moderate symptoms of poisoning can readily occur among persons exposed to esfenvalerate, especially if the product is misused. These symptoms can be aggravated by exposure to sun, heat, and water which means that field workers are likely to have greater problems than those exposed indoors. There was some evidence to suggest that esfenvalerate may be a problem for persons with asthma or other respiratory allergies.

VII. Recommendations

Protective clothing or other protective equipment to avoid skin, eye, and respiratory exposure is recommended for any workers likely to come into substantial contact with esfenvalerate.

References

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