



Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333
AUG 10 2006

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Dear Mr. Mayorga:

This letter is in response to your request to evaluate potential arsenic exposures at the McMillian Park in the Miami-Dade County area. The herbicide MSMA (monosodium methylarsonate) contains arsenic and is the contaminant of concern. As discussed via teleconference, the Agency for Toxic Substances and Disease Registry (ATSDR) agreed to address the following questions:

- 1- Based on available data, is there a health risk for people who engage in recreational activity at McMillian Park because of the arsenic herbicide use on park grounds?
- 2- Based on available data, is there a possible association between arsenic pesticide application on the park grounds and the two children who experienced respiratory symptoms at the park?

Included below are a list of all documents ATSDR reviewed in order to address this request:

1. January 31, 2006: Memorandum on incident at McMillian Park to Kenneth Brown from Robert Marton at GSA-RMD.
2. January 23 and February 22, 2006: DERM sampling results for surface soil.
3. March 30 and April 18, 2006: Letters requesting Public Health Assessment for McMillian Park from DERM to Florida Department of Health (FDOH), and the response from FDOH.
4. June 5, 2006: Soil Summary Data table provided electronically by Mr. Wilbur Mayorga.
5. June 19, 2006: Information on two children who experienced respiratory symptoms at the park. All personal identifiers have been removed. Provided by Mr. Juan Suarez.

Toxicological Summary:

Assuming the described exposure scenarios to site-specific arsenic levels, risk assessments conducted by the Environmental Protection Agency (EPA) or health evaluation conducted by ATSDR do not indicate a cause for concern for cancer or noncancer health effects for acute or chronic exposure to soil or turf after recommended applications of MSMA.

Exposure to the two school children occurred a full day after application of MSMA. Based on physical properties, volatilization of MSMA would not be expected to be a significant route of dispersal. ATSDR does not consider respiratory effects as a sensitive endpoint following exposure to organic arsenicals by either the inhalation or oral exposure route. It is unlikely that dermal exposure would result in acute systemic effects from exposure to MSMA, although local skin irritation could not be ruled out. For a full discussion of the toxicological evaluation, see the attached appendix 1.

Medical Summary:

ATSDR reviewed data available on the two children who experienced respiratory symptoms at the park. To protect privacy, a more detailed discussion of the medical evaluation is not provided. The children were discharged home in good condition after observation in the hospital. No other treatments were indicated during the hospital evaluation. It is not clear from the description of the park incident or the hospital summary whether the arsenic in the MSMA is associated with their symptoms. Other explanations, such as sensitivity to MSMA, the inert ingredients in MSMA or other substances could have also contributed to the incident. In short, an association between the arsenical herbicide and the two children with symptoms at the park cannot be clearly determined. However, it is still prudent to take appropriate public health measures and apply herbicides as directed by the manufacturer. If indicated, public parks should have adequate visual signs posted when an application has occurred with instructions for the public.

Conclusions:

- 1- Based on available data, there appears to be no apparent public health risk to arsenic exposure from MSMA application at the McMillian Park.
- 2- Based on available data, it cannot be determined that arsenic in the MSMA contributed to the symptoms of the two children at the park.

Recommendations:

- 1- Follow prudent public health guidelines when applying pesticides/herbicides to public parks.
- 2- Assure proper application and notification of recent product application on park grounds.

If additional data becomes available later, ATSDR will be glad to consider a separate request for an evaluation. If there are questions regarding this health consultation, please contact Ketna Mistry (404)498-0451 or David Fowler (404)498-0463.

Sincerely,

Susan W. Metcalf MD for Ketna Mistry

Ketna Mistry, MD
Exposure Investigations and Site Assessment Branch
Division of Health Assessment and Consultation
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Appendix 1: Toxicological Evaluation

Discussion

Monosodium methanearsonate (MSMA) is an organic pentavalent arsenical herbicide. The toxicity of arsenic compounds is highly dependent on methylation status and valence state, with unmethylated forms being more toxic than methylated forms and trivalent forms being more toxic than pentavalent forms. MSMA can be metabolized in soil to a di-methyl organic arsenical (DMA) or to inorganic arsenic, the most toxic form of arsenic. Results of studies investigating the conversion to inorganic arsenic are extremely variable, ranging from no conversion to approximately 80% (1). When dissolved in water, MSMA becomes pentavalent methanearsonic acid (MMA). In contrast with inorganic arsenic, ingested MMA exhibits limited cellular uptake and has low affinity for the methyltransferases responsible for sequential addition of methyl groups. Ingested MMA is excreted mostly as the parent compound without further metabolism, in humans and most animals, except the rat. Thus, the potentially cytotoxic trivalent intermediates are hardly formed in humans. MMA is not carcinogenic in rats or mice and is not readily metabolized to DMA (which may be carcinogenic in animals) in humans (2).

When MSMA is applied to turf and soil, it may be metabolized and/or redistributed through runoff, leaching, erosion, volatilization, or plant uptake. Metabolism to volatile alkylarsines is possible under certain conditions, but is generally not likely to be a major route of dissipation. Based on physical properties, volatilization of MSMA would not be expected to be a significant route of dispersal (1). ATSDR does not consider respiratory effects as a sensitive endpoint following exposure to organic arsenicals by either the inhalation or oral exposure route (3). Dermal exposure in rabbits did not produce significant toxicity (4).

The occurrence, rate, and products of soil microbial metabolism are variable, dependent on environmental conditions. The observed persistence of organic arsenicals in aerobic soil has ranged from weeks to years, depending on soil properties and ambient conditions such as soil moisture, temperature, chemicals concentration, and amount of organic matter. Based on several studies showing estimated first-order "half-lives", in aerobic and anaerobic soils ranging from months to nearly a year, a calculated aerobic soil half-life of 240 days was used in fate and transport modeling for MMA. Some of the variability in metabolic processes is associated with variability in sorption processes. Soil microbial metabolism of organic arsenicals only occurs while the compounds remain dissolved in pore water. As the arsenicals sorb to soil, they become less accessible to microbes and therefore less likely to be metabolized. Sorption variability is largely controlled by soil properties including the clay content, the iron and aluminum content, and the soil pH. Lab studies have shown that in some situations, significant sorption of arsenic compounds may occur within hours of application, while others show a large portion of applied arsenic remains in water-soluble forms for days or months after applications (1).

Submitted studies show that a large fraction of applied arsenic remains in the top layers of soil. After repeated applications for multiple years, soil arsenic levels could be expected to increase, making the possibility of soil buildup a long term concern. Soil accumulation values generated by environmental fate and transport modeling indicate maximum application rates for MSMA on turf and cotton, and assuming moderate sorption, would result in arsenic accumulation in the top 10 cm of soil with little dissipation for several years, and then level off. Over the long term, the build up of total arsenic from MSMA application is predicted to reach persistent concentrations of approximately 45 ppm on turf (1). This level corresponds to the maximum values detected in McMillan Park (max - 49 ppm, mean – 22 ppm) which has received MSMA applications for greater than 10 years, and similar to the golf course data (max – 55 ppm, mean - 19 ppm), duration of application unknown.

Uncertainty

Environmental data were limited. The environmental sampling reports the results as total arsenic. The proportion of inorganic arsenic (the most toxic form) to MSMA is not known but likely to be less than 80%. Risk assessments estimates were based on inorganic arsenic, as health-based comparison values have not been established for MSMA. Therefore risk assessments based on inorganic arsenic likely overestimate the risk.

Composite soil samples were collected from 0 to 6 inches. In reality, exposure generally occurs to the top inch or two of soil, so actual concentrations at which exposure occurs may be underestimated from these samples. Background information was not provided.

Health Risk Assessment

The public health risk assessment of exposure at McMillan Park was addressed in two ways.

1. A postapplication phase (day 0) noncancer risk assessment based on recommended application rates has been conducted by the Environmental Protection Agency (EPA)(5). EPA conducted detailed noncancer risk assessments on the following most likely residential postapplication exposure scenarios:
 - Dermal exposure from residue on lawns (adult and toddler);
 - Hand-to-mouth transfer of residues on lawns (toddler);
 - Ingestion of pesticide treated grass (toddler); and
 - Incidental ingestion of soil from pesticide-treated residential areas (toddler).

The residential exposure is a worse case exposure compared to a recreational exposure. All assessments indicated no cause for concern for MSMA at the recommended application rate to the most sensitive receptor, including aggregate risks. The results of all assessments indicated an exposure dose more than 100 times less than the target dose at which no adverse effects were found in

experimental animals, and the combined incidental oral exposure was also estimated to be more than 100 times less than the target dose (5).

2. ATSDR conducted risk assessments for acute and chronic noncancer recreational exposures and a cancer risk estimate based on a recreational exposure.

Acute

ATSDR conducted a risk assessment based on inorganic arsenic at the maximum detected value (49 ppm), assuming an acute recreational ingestion exposure of 50 mg to a 15 kg toddler. The estimated exposure dose (0.0002 mg/kg/day) was well below ATSDR's acute minimum risk level (MRL) of 0.005 mg/kg/day. Exposure at the MRL is considered to be protective from adverse health effects even in sensitive populations (6).

Chronic

ATSDR conducted a risk assessment based on a chronic recreational exposure to inorganic arsenic assuming ingestion of 50 mg soil containing the mean total arsenic level (22 ppm) to a 70-kg individual. The estimated exposure dose (0.00002 mg/kg/day) was well below ATSDR's chronic MRL of 0.00013 mg/kg/day (6).

Noncancer health effects would not be expected from exposure to soil containing MSMA and inorganic arsenic. Because inorganic arsenic is more toxic than MSMA, all assessments were conducted based on inorganic arsenic as a worst-case scenario assuming a recreational exposure as the most likely scenario. Acute and chronic exposures to arsenic were considered.

Cancer risk

Cancer health effects would not be expected from a recreational exposure at McMillan Park to inorganic arsenic in soil. While some increase in the risk for developing cancer is assumed from any exposure, no matter how small, the estimated increase in risk from inorganic arsenic at McMillan Park is very small. In addition, total arsenic was reported and used as the exposure contaminant; in reality, only a portion of the contaminant was inorganic arsenic, which could overestimate the actual risk. ATSDR's comparison value for inorganic arsenic is usually below background levels so the recommended comparison value is 20 ppm, which is similar to the detected mean (22 ppm) for total arsenic at McMillan Park. ATSDR calculated the estimated increase in risk assuming a 30-year exposure for 250 days/year to a 70 kg individual ingesting 50 mg soil with a mean concentration of 22 ppm inorganic arsenic using EPA's Cancer Slope Factor (7). The resulting estimate of the increase in risk was 7E-06, which is not considered by ATSDR as a significant increase in risk (8).

References

1. USEPA. Office of Prevention, Pesticides and Toxic Substances. Health Effects Division. Memorandum, March 29, 2006. Organic Arsenics: HED Combined Chapter of the Reregistration Eligibility Decision Document.
2. Cohen, SM and Arnold LL. Methylated Arsenicals: The implications of metabolism and carcinogenicity studies in rodents to human risk assessment. *Critical Reviews in Toxicology*, 2006. 36:99-133.
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4. USEPA. Federal Register Environmental Documents. 40 CFR Part 372. Monosodium Methanearsonate and Disodium Methanearsonate; Toxic Chemical Release Reporting; Community Right-to-Know. April 20, 1995.
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8. ATSDR. Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. Draft for Public Comment. September, 2002. US Department of Health and Human Services. Atlanta, GA.