

# An Assessment of the Risks Associated with Pesticides Volatilized and Dislodged from Golf Turf

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## Objectives:

1. Identify golf practices and habits which lead to exposure from dislodged pesticides.
2. Quantify the amount of various pesticides dislodged, volatilized, and transferred during play.
3. Characterize the risk incurred by pesticide exposure while playing golf.

**Start Date:** 1998

**Project Duration:** 5 years

**Total Funding:** \$125,000

Herbicides containing monosodium methanearsonate (MSMA) often are used for weed control in bermudagrass (*Cynodon sp.*) golf greens and fairways. In a recent survey of Florida golf courses, 96% of the respondents had used MSMA within the past three years, and over 70% made multiple applications. MSMA contains arsenic (As) which is suspected to be responsible for various cancers (bladder, kidney, liver, lung, and skin). The USEPA has established a drinking water standard for As of 10 micrograms L<sup>-1</sup>, and a variety of standards have been established as clean-up goals for various soils.

The Dade County Department of Environmental Resources Management conducted a study of arsenic in groundwater and surface soils from golf courses in collaboration with the Florida Department of Agriculture and Consumer Services. Up to 815 micrograms As L<sup>-1</sup> was found in groundwater, and 120.7 mg As kg<sup>-1</sup> soil was found in the surrounding



Dr. George Snyder rubs turf with moistening cheesecloth to sample for dislodgeable residues following MSMA application.

surface soil, which probably resulted from pesticide spillage, rather than from routine use. However, no direct measurements of volatilized arsenic, or of arsenic as dislodgeable residues, or in percolate, grass clippings, or soil following label-rate applications of MSMA to golf greens are available. Our study, conducted in cooperation with Dr. Ming Chen (University of Florida) and Dr. Yong Cai (Florida International University), is designed to obtain these data for MSMA, and to assess risks to golfers from MSMA.

A commercial grade MSMA was spray-applied at three weekly intervals in September, 2002 at the maximum recommended rate of 0.224 g m<sup>-2</sup> (2 lbs a.i. acre<sup>-1</sup>) to established 'Tifdwarf' bermudagrass plots in a USGA green at the Ft. Lauderdale Research and Education Center. No arsenic had been applied to these plots previously. The plots contained lysimeters for recovering percolate. There were four replications of four rootzone media in the study, all having USGA-specification sand texture: 1) quartz sand, 2) quartz sand with 10% (volume) sphagnum peat, 3) naturally-coated (goethite, gibbsite, kaolinite, hydroxy-interlayer vermiculite) sand with 10% peat, and 4) artificially clay-coated (Ca-montmorillonite) sand with 10% peat.

At weekly intervals, percolate water was recovered, and clippings were collected. On two occasions, an adjacent area on the green was sprayed with MSMA for measuring dislodgeable residues at several time intervals following MSMA application. The percolate water was analyzed for various arsenic species, and the plant tissue, soil, and cheese cloth will be analyzed for total arsenic. Studies of arsenic volatilization following application to the green are planned.

During the first month following the initial MSMA application, most arsenic leaching was either in the dimethylarsinic acid (DMA) or As (V) form, and the latter increasingly predominated over time.

These results indicate that both methylation and decomposition occur after applying MSMA. Average arsenic concentration over this time period (mean weighted flow average) was substantially greater for the rootzone containing only quartz sand, whereas there were no statistical differences ( $P < 0.05$ ) among the rootzones containing peat. Nevertheless, the average concentration of arsenic in percolate among the latter was substantially greater than the pre-applications concentration (142 vs. 1.2 micrograms arsenic L<sup>-1</sup>).

## Summary Points

- Concern is mounting about the use of MSMA for weed control in golf courses because it contains arsenic (As) which is suspected to be responsible for various cancers.
- Elevated concentrations of As have been found in soil and groundwater from Florida golf courses.
- Our study is designed to obtain direct measurements of volatilized arsenic, and of arsenic as dislodgeable residues, in percolate, grass clippings, and in soil following label-rate applications of MSMA to golf greens.
- Both methylation and decomposition of MSMA occurred in the soil after application.
- Following MSMA applications, lower concentrations of As were found in percolate from rootzone mixes containing peat. Nevertheless, As concentrations were substantially greater than in pre-application percolate.