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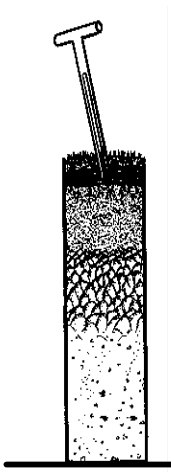

THE SOIL PROFILE

A newsletter providing information on issues relating to soils and plant nutrition in New Jersey

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Public Health Concerns with Hazardous Materials in Fertilizers

For many years commercial fertilizers have been regulated to ensure that the product label provides accurate information on essential plant nutrient content. In recent years, however, concerns about quality in some fertilizer and liming products have extended beyond nutrient content to the potential presence of non-nutrient toxic substances, such as heavy metals.

The application of fertilizer products that have a high content of heavy metals results in the build up of heavy metals in soil. This increases the potential for exposure of crops, animals, and humans to toxic elements. Both organic and chemical fertilizer products may be at risk for heavy metal contamination. Generally, the most serious cause of heavy metal contamination results when industrial by-products are recycled into fertilizers. Micronutrient fertilizers, for example, are frequently derived from recycled industrial wastes.

While the presence of toxic elements in fertilizers and liming materials is an environmental and health concern, there are no standards for levels of contamination in most states, including New Jersey. Unfortunately, a series of loopholes in USA federal law controlling solid waste, hazardous waste, and mine tailings have the effect of allowing the application of what would otherwise be considered as hazardous materials as fertilizer. European countries and Canada regulate fertilizers for heavy metal contaminants to prevent their build up in soils. In the United States, regulation of fertilizers is the responsibility of the individual states.

Information and resources in this newsletter are provided in effort to minimize public exposure to heavy metals from fertilizers in the current unregulated market. Although New Jersey has no official standards that are specific for heavy metals in fertilizers and liming materials, the USEPA standards for heavy metals in sewage sludge have been used as a reference (Table 1). The Canadian standards are also given here as a reference; http://www.inspection.gc.ca/english/plaveg/fereng/tmemo/t-4-93e.pdf

A recent national study of fertilizer source materials used to supply major nutrients (N-P-K) concluded that these materials generally do not contain significant amounts of heavy metals to be of immediate concern. Of the three major nutrients, the main focus of attention for non-nutrient contaminants is in phosphate fertilizers. Rock phosphate, the starting material from which most phosphate fertilizers are manufactured, contains varying amounts of cadmium, ranging from trace to greater than 100 ppm. Rock phosphates from Florida contain 9-17 ppm cadmium and North Carolina rock phosphate contains about 47 ppm cadmium. Because there is a limited supply of low cadmium rock phosphates and a high cost for removing the cadmium during manufacture, there usually remains a significant presence of cadmium in phosphate fertilizers. The long-term accumulation of cadmium in soil from phosphate fertilizers is influenced by the rate and frequency of their application over time. As a result of years of phosphorus application there is now an abundance of phosphorus enriched soils in the Mid-Atlantic region with less than 22% of soils testing below optimum. There are already many well recognized environmental reasons for reducing unnecessary phosphorus applications to soil; minimizing cadmium accumulation in soil is another. Rock phosphates also contain relatively high levels of fluoride, ranging from 1,900 to 42,400 ppm. The environmental significance of fluoride accumulation in soils and crops from phosphate fertilizers has so far not received as much attention as heavy metal contamination.

Micronutrient fertilizer source materials have also been examined recently. Studies have found that some products contain high levels of heavy metal contaminants such as lead, arsenic, or cadmium

(Environmental Impact of Fertilizer on Soil and Water by W. Hall and W Robarge, 2004).

While the great majority of commercial fertilizer products are generally regarded as safe and free of harmful levels of heavy metal contamination a limited number of products of concern have been identified in the garden center and fertilizer dealer market place. An example of a product of concern that is widely available in the home garden fertilizer market is Ironite. A recent study found that Ironite contains up to 3600 mg/kg As and 2900 mg/kg Pb and that solubility testing indicates that the product should be classified as a hazardous waste. On August 15, 2005, the New Jersey Department of Agriculture issued a "stop sale" on Ironite 1-0-0, but other Ironite products remain on the market.

A limited survey of commercial products obtained from fertilizer dealers in New Jersey, conducted by Rutgers Cooperative Research and Extension, identified one zinc product of concern that contained 83 mg/kg Cd (Table 2). Also analysis of a commercial liming material found a Ni concentration of 194 mg/kg. New Jersey state officials, garden centers and fertilizer dealers are being informed about these suspect products.

In New Jersey, commercial fertilizer products are regulated for guaranteed nutrient concentration by the New Jersey Department of Agriculture (NJDA). Although concentrations of non-nutrient substances in fertilizers and liming materials are not currently regulated, the NJDA will, on request from the public, test product samples for some heavy metals of concern. When a farmer, gardener, or fertilizer dealer has concerns about the guaranteed nutrient concentration in a fertilizer, quality of a liming material, or possible contamination of a product with heavy metals, the product in question may be sampled and tested by the NJDA, P.O. Box 330, Trenton, NJ 08625. Phone: 609-984-2222.

In Washington State, all commercial fertilizer products must be tested for nine different heavy metals and the results posted on the web: http://agr.wa.gov/PestFert/Fertilizers/default.htm

Because many of the fertilizers listed at this web site are national brands, farmers and gardeners in New Jersey may find this information helpful for selecting products with the lowest level of heavy metal concentration.

Concerns with Perchlorate in Fertilizers

Recent findings of perchlorate (ClO_4^-) in drinking water, vegetables, cows milk, and human breast milk have drawn attention to fertilizers as a possible source of this chemical. The perchlorate ion, which is similar in size to iodide, is absorbed in the gastrointestinal tract. Perchlorate competes with iodide for uptake by the thyroid gland and this may result in low thyroid hormone production and associated diseases. Impairment of brain development is a concern with fetuses and children.

Perchlorate contamination of surface and ground water has been confirmed in 19 states including New Jersey. While there is currently no standard for perchlorate in drinking water, it is subject to unregulated contaminate monitoring. In California, the provisional action level is 18 ppb perchlorate in drinking water.

There are many sources of perchlorate contamination of the environment but fertilizers are not a major source. The main sources of perchlorate are related to military operations and the defense industry where perchlorate is used as a rocket fuel or in ammunitions.

Perchlorate is also used in fireworks, road flares, and in air bag deployment systems. Fertilizer brands that may contain perchlorate as a result of their being manufactured from caliche ores include Bulldog Soda, Hi-Yield, Hoffman, and other unknown fertilizer blends. Overall less than 0.2% of fertilizer tonnage in USA is manufactured from caliche ores. Thus, the majority of fertilizers do not contain perchlorate.

While plants do uptake perchlorate from soil, it is not known how much this contributes to the risk of human exposure. Our current understandings of the risk of perchlorate exposure are limited. While investigations are underway it is difficult to formulate agricultural and environmental recommendations regarding perchlorate.

But considering that Chilean nitrate fertilizers are known to contain perchlorate, growers may at this time consider using alternative nitrogen sources as a precaution.

Fertilizer source materials are generally free of perchlorate but Chilean nitrate is known to contain perchlorate. Chile possesses caliche ores rich in sodium nitrate that also contain perchlorate of natural origin. When nitrate fertilizers, such as sodium nitrate or potassium nitrate, are manufactured from caliche ores, they may contain 100 ppm or less of perchlorate. These nitrate sources when incorporated into other fertilizers result in the addition of perchlorate to these products.

Table 1. Canadian Standards for fertilizers, USEPA Standards for sewage sludge, and Rutgers Cooperative Research and Extension suggested limits for sewer sludge

Element	Canadian Maximum Acceptable Concentration[1]	Canadian Maximum Acceptable Cumulative Addition to Soil			USEPA Part 503 Sewage Sludge	RCRE Suggested Limits for Sewage Sludge	RCRE Suggested Soil Limits (not for sandy soils)
	ppm	kg/ha	lbs/acre	lbs/acre/yr	----------ppm----------		
Arsenic	75	15	13.38	0.297	41	41	1.0-2.0
Cadmium	20	4	3.568	0.079	39	21	2
Cobalt	150	30	26.76	0.594	n/a	n/a	n/a
Mercury	5	1	0.892	0.019	17	17	1
Molybdenum	20	4	3.568	0.079	n/a	18	4
Nickel	180	36	32.11	0.713	420	420	35-50
Lead	500	-	-	-	300	300	150
Selenium	14	2.8	2.497	0.055	100	28	5
Zinc	1850	370	330	7.329	2800	2800	130-200
Copper	-	100	89.2	1.98	1500	1500	60-100
Chromium	-	-	-	-	-	1200	-

[1] Bi-products containing 5% N or less and represented for sale as fertilizer or supplements

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Table 2. Chemical Analysis of five different commercial zinc fertilizers for As, Cd, Pb, Ni, Se and Zn

Company/Product	As	Cd	Pb	Ni	Se	Zn	Product Appearance
	----------ppm----------					%	
Plant Food Chemical Green T Zinc, 7% Zn	< 0.3	< 3	< 10	< 5.1	< 0.5	7.5	Brown Liquid
Agrium Inc Ultra Yield Zinc Ox:Sulfate	0.7	< 5	< 19	< 10	< 1.0	27.3	White with a few gray pellets and blue pellets
Unknown Brand $ZnSO_4$, 31%Zn	0.7	< 6	< 20	< 10	< 1.0	28.6	White with a few gray pellets
American Micro Trace Coarse Zinc	0.9	83	< 19	< 10	< 0.9	36.6	Beige
CoZinco Sales Granular Zinc, 31% ZN	< 0.5	< 6	< 20	< 10	< 1.0	29.3	White with many gray pellets, some blue and black

Disposal of Hazardous Waste Products

Home gardeners that want to properly dispose of hazardous products can find contact information for the Household Hazardous Waste Coordinators at http://www.state.nj.us/dep/dshw/rrtp/hhwcps.htm

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