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AgriLIFE EXTENSION
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Lead in Your Garden Soil ?

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What is Lead and is it a Problem?

In the spring of 2009, the New York Times (May 13, 2009) and the Austin Statesman (May 23, 2009) printed articles discussing the potential for lead (Pb) in garden soils around our homes. This bulletin gives you information about the potential for Pb to be in the soil around your homes and if it is a potential problem for us and our children, or pets and animals.

Lead is a naturally occurring element in soils. The common concentration range for Pb in soils is from 2 to 200 milligram per kilogram (mg/kg) or parts per million (ppm) on a mass to mass basis with an average of 10 ppm (Lindsay, 1979). A research project evaluating metal concentrations in 100 soils (three soil depths per soil for 300 soil samples) from seven Natural Regions of Texas was conducted in 1997 and 1998 (Frybarger, 1998). The Natural Regions represented in the study were East Texas Timberlands, Claypan, Coast Prairie, Edwards Plateau, Grand Prairie, Blackland Prairie, and Central Basin (Figure 1). The samples were collected by USDA Natural Resources Conservation Service (NRCS) and Texas AgriLife Research from about 1980 to 1997 for the county soil survey reports. The sites where the soil samples were collected were in rural areas such as pastures, forests, and cropped fields away from major highways. The research showed that the average concentration of Pb was 14 ppm with a range of 2 to 33 ppm. So, what is considered a high concentration of Pb? According to the US Environmental Protection Agency and the US Department of Housing and Urban Development, it is advised, but not required, to remediate the soil if the Pb concentration exceeds 400 ppm where children play and 1,200 ppm anywhere else.

According to information from Texas Commission on Environmental Quality (TCEQ), the Protective Concentration Level (PCL) for Pb is 500 ppm. This PCL is designed to be protective for long-term exposure (350 days/year for 30 years) from incidental ingestion, inhalation, dermal contact with soil, and ingestion of vegetables grown in the soil. Long- or short-term exposure to this concentration in the soil would not be expected to result in adverse health effects, even to sensitive members of the population (TCEQ, 2009).

Why is Pb a concern at all? The primary concern is if we ingest or inhale it. Lead has no known physiologically relevant role in the body. The toxicity of lead comes from its ability to substitute for other biologically important metals, most notably calcium (Ca^{2+}), iron (Fe^{2+}), and zinc (Zn^{2+}). These act as cofactors in many enzymatic reactions. Lead is able to bind to and interact with many of the same enzymes as these metals but, due to its differing chemistry, does not properly function as a cofactor, thus interfering with the enzyme's ability to catalyze its normal reaction(s). It is removed from the body extremely slowly, mainly through urine, causing accumulation in the tissues. Approximately 95% of the absorbed lead is deposited as a lead phosphate complex in the bones (Trace Element and Micronutrient Unit). Some potential symptoms of chronic lead poisoning include neurological, kidney, and reproductive problems and anemia (Eisinger, 1982). Lead poisoning is nothing to play with, so if you believe that you have Pb poisoning, seek proper medical attention as soon as possible.

There are two major ways that Pb contaminated soils around homes prior to 1990. One was through Pb based paints used prior to 1978 chipping off the home and becoming incorporated into the soil. The other way was to live within 50 feet of a very busy highway, such as an Interstate Highway, prior to 1970 when tetraethyl lead was taken out of our gasoline. Leaded gasoline was completely phased out by 1990.

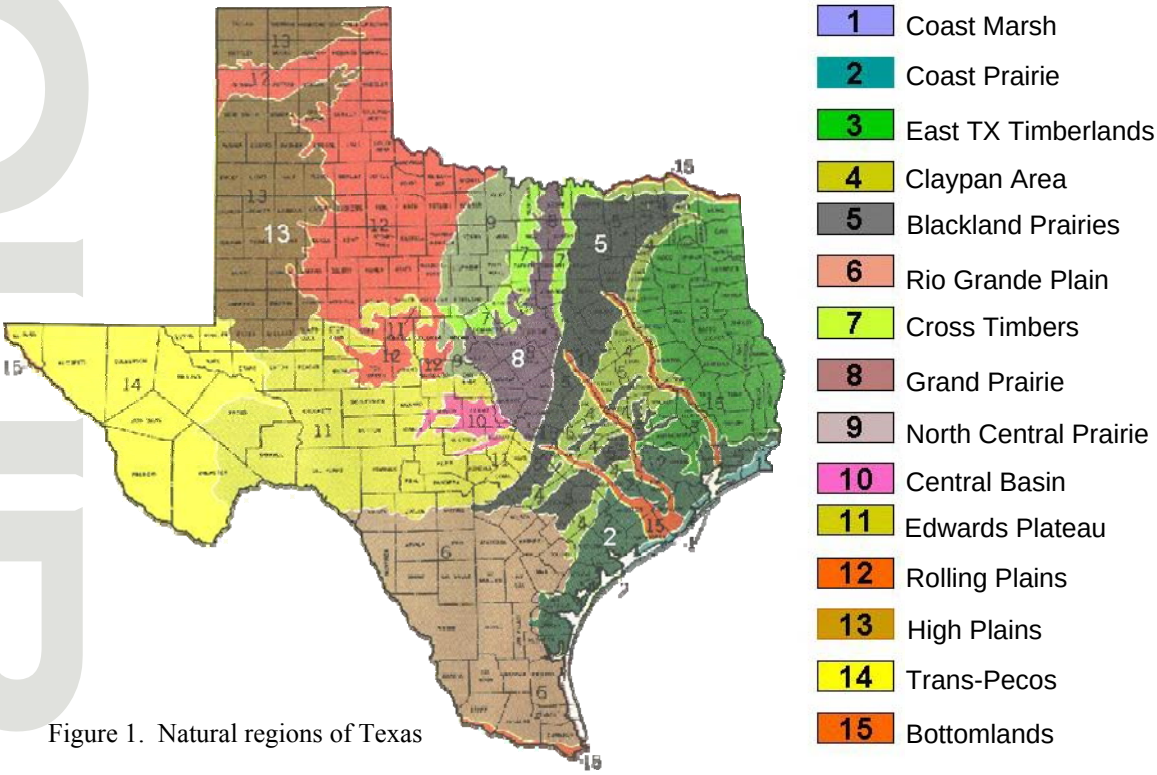

Figure 1. Natural regions of Texas

"How do I Determine if I Have a Problem with Lead in My Soil?"

"So, how do I know if I have a potential Pb problem?" The *first question* to answer about whether your garden soil might have higher concentrations of Pb in it is **"When was my home constructed?"** Homes build before 1978 and made mainly of painted wood or siding exhibit the highest potential for having higher than normal levels of Pb in the soil. Lead was removed from paint in 1978, thus homes built after this year or brick homes, should not have had paint containing Pb used on them. The *second question* is **"Where is my garden located?"** If it is outside the drip line of the roof and about 15 to 20 feet away from that drip line, there probably is not a problem. The *third question* to answer is **"What is the pH of my soil?"** If the pH is 7 or greater, there probably is not a problem. Basically, pH is a simple number system devised to represent the acidity or alkalinity of a given substance expressed in a range from 0 to 14 with 7 being neutral. The main thing to remember is that numbers below 7 are acid; therefore, the lower the number, the stronger the acidity. Conversely, numbers above 7 are basic with 14 being the most alkaline. This is somewhat counterintuitive in that it appears backwards. Most plants perform best if the soil pH is near neutral to slightly acid. The pH plays a vital role in the ability of Pb to be taken up by plants. The more acid (less than pH 7) the soil is, the higher the potential for Pb to be taken up by plants and vice-versa, the more alkaline (pH greater than 7) the soil is, the less the potential for Pb to be taken up by plants.

The *fourth question* is **"Was this home site within 50 feet of an interstate highway or very busy highway before 1990?"** If the answer is no, there probably is not a problem. The *fifth question* to ask is **"What kind of plants am I growing in my garden?"** The potential Pb problem depends on where on the plant the fruiting body grows and the type of fruiting body.

Answers to the Questions

"If I have determined that there is a potential for higher than normal concentrations of Pb, what do I do next?"

Let's take each of the situations listed above and develop a process.

If your home was constructed before 1978, was painted, and the garden is within the drip line of the roof plus about 15 to 20 feet, the best solution is to move the garden outside this boundary and there should not be a problem.

If you have soils with pH values less than 7, and your home was built before 1978, and painted, then there is a potential to have elevated Pb levels. Generally across Texas, most soils east of Interstate 45 have pH values less than 7. Between Interstate 45 and 35 pH values are above and below pH 7 and west of Interstate 35, they are usually 7 or above. However, there are always exceptions. Agricultural limestone can be used to raise the pH of the soil. However, before limestone is added, be sure to know the pH requirements of your crop and how much limestone to apply. For instance, acid loving plants such as blue berries and azaleas do not require limestone until a pH 5.2 or less. However, most other crops range from 5.8 (most of the non legume plants) to 6.2 (legumes) before limestone would be recommended. A soil test report from an agriculture soil testing laboratory usually contains a liming requirement to help determine how much is needed.

If your garden is within 50 feet of a major highway built before 1970, the best protection would be to move the garden farther away. This assumes that your yard is large enough to move at least 50 feet away from the side of the road. The traffic on neighborhood streets is not sufficient to cause Pb contamination.

If you are growing vegetables that grow in or on the soil such as potatoes, carrots, cucumbers, squash, etc. the best thing is to wash them thoroughly to get as much of the soil off as possible and then peel the vegetable to remove any soil residue. If the fruiting body grows above the soil such as tomatoes, peppers, beans, egg plant, etc. these are probably safe to eat after a thorough washing. If you are growing leafy vegetables such as leaf lettuce, spinach, collard greens, mustard greens, etc., then you definitely need to test your soil and make sure that the levels of Pb are below elevated concentrations. Studies have shown that plants accumulate Pb in their vegetative portion, i.e. stems and leaves, but not in the fruiting bodies. We suggest that if you have pH levels less than 7 and total Pb concentration exceeding 400 ppm or the pH is greater than 7 and the total Pb concentration exceeds 1,200 ppm, that you move your garden to another area or remediate the soil (see below). We also suggest that if the total Pb is greater than 400 ppm that you not let children play in the area no matter whether the soil pH is less than or greater than 7.

"What do I do if I Have a Potential Problem with Lead?"

The first thing is to collect a representative soil sample and send it to a National Environmental Laboratory Accreditation Conference (NELAC) accredited soil environmental laboratory for analysis for **total Pb**. These types of laboratories can be found usually in the Yellow Pages under "Laboratories – Analytical" or there is a listing on the TCEQ website http://www.tceq.state.tx.us/assets/public/compliance/compliance_support/qa/txnelap_lab_list.pdf under "Solid and Chemicals". This soil test will usually cost about $40 per sample. To determine the amount of nutrients needed for the plants in your garden, you should use an agricultural soil testing laboratory, not an environmental soil testing laboratory. The routine soil test of most agricultural laboratories will cost about $10 to $15. The state soil testing laboratory is the Texas AgriLife Extension Service Soil, Water and Forage Testing Laboratory located at Texas A&M University in College Station, TX. The routine soil test is $10 and includes pH, salinity/electrical conductivity, nitrogen, phosphorus, potassium, calcium, magnesium, sodium and sulfur. For more information, please go to the website, http://soiltesting.tamu.edu, or call 979-845-4816. There are numerous other agricultural soil testing laboratories across the state and nation that can also be used. Always contact the laboratory first to make sure if there are any special sample collection techniques, containers required to store and ship the soil samples, and if there is a time frame that the analyses must be started.

The soil can be remediated several ways. You can build a raised bed that is at least 12 inches above the native soil. Provided the soil has a Pb concentration below 1200 ppm, you can add agricultural limestone to raise the pH above 7, always being mindful of the crop you are growing as discussed above. The soil can be removed to 12 inches and replaced with new "top soil". This will be the most costly because the soil removed may have to go to a disposal site that receives Pb contaminated soil. You will need to contact TCEQ to determine this (see information below).

Another potential is to phytoremediate the soil. This is done with leafy vegetables as mentioned above. These plants are metal accumulators and would need to be harvested and thrown away, not put in a compost pile. We suggest soil testing after each year to determine when the Pb level has decreased below the desire concentration. Phytoremdiation will require several years, depending on the initial total Pb concentration in the soil.

For additional information or questions you might have, please contact Dr. Sam Feagley at sfeagley@ag.tamu.edu or 979-845-1460. Contact information for TCEQ Toxicology Division is (toll-free) 1-877-992-8370 and for approved disposal locations TCEQ Waste Classification Group

List of References Cited

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