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JOHN'S CORNER:

NEWS FROM THE WONDERFUL WORLD OF SOIL AND PLANTS

by John Ferguson

I was reading in the July issue of Life Extension an article on vitamin studies and there was some interesting data presented on the interaction between minerals (actually elements) and vitamins.

Numerous times we talked about the importance of magnesium (Mg) as it activates and is used in over 300 enzymes in humans. This includes the enzymes required for vitamin D to work and protect us against diseases for example.

It is estimated the amount of magnesium in our food has decreased 25-80% since 1950 and in society today between 60-80% of all people are magnesium deficient.

Numerous times we have discussed how glyphosate, the active ingredient in round-up binds to magnesium (zinc and other elements) and prevents the body from absorbing what little amounts of these elements that are in our food to begin with.

It is well known that magnesium and zinc are required for our bodies to fight off viruses. These two factors explain why many doctors are having tremendous success in treating and preventing covid using mineral supplements and vitamins.

This supports that we as gardeners need to grow more of our own fruits and vegetables organically as possible. The book "Metabological" I reviewed a few weeks ago, goes into great detail on how the poor quality of our food supply is causing most of our health problems and contributing to the current pandemic.



The July issue of “Physics Today” has an interesting article on a new form of mining called “Phytomining”.

We are all familiar with the term bioremediation where microbes are used to clean up things like oil spills. Later came the term phytoremediation using plant roots to cause conditions where they provide energy and root exudates to help microbes break down toxic chemicals in the soil.

Often in nature elements occur in rocks and sediments at such a low level that it is not economical or even possible to extract them where they could be used. Researchers are now studying plants that are hyper-accumulators of various elements and this process of using plants to collect elements from the soil is called Phytomining.

One of the benefits of Phytomining is that traditional hard rock mining is energy intensive which generates a lot of greenhouse gasses and pollution, and farming plants do not. For example, to produce one ton of cobalt over 1,000 tons of waste are generated.

The world is facing a shortage of rare earth elements used to make computer chips to superconductors and many other elements used in all kinds of everyday products. Many soils have low amounts of these elements in them that occur from the weathering of rocks into soils, and that is where the plants come in.

Many plants accumulate the element nickel (Ni) in their tissues. The soils may only have a few hundred parts per million but the plant will collect and concentrate nickel to levels one thousand times higher.



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Many plants can accumulate elements like cobalt (Co) used to make lithium-ion batteries for electric cars and devices or accumulate the rare earth elements for computer chips and super magnets for medicine, or even arsenic (As).

A few examples are: *Phyllanthus rufus chaneyi* accumulates nickel. The Indian Mustard plant, is particularly adept at soaking up lead, cadmium, chromium, nickel, zinc, and copper.

Alpine pennycress, a small perennial herb, has been found to be a hyperaccumulator of cadmium and zinc, holding 30,000 ppm of zinc in its leaves without loss of growth compared to 500 ppm for most plants.

Sunflowers (*Helianthus* sp.) have the ability to remove radioactive and toxic metals from soil and water. Some strains of sunflowers can remove up to 95% of toxic contaminants in 24 hours and will remove all contaminants in longer time frames. One test in Ohio showed that water containing 350 ppb uranium entered the test plot and emerged at 5 ppb or less, well below the EPA standard of 20 ppb. A test at Chernobyl in Russia found that sunflower growing on styrofoam rafts had roots that registered 8,000 times more cesium and 2000 times more strontium than the surrounding water.

A team of researchers at the University of Guelph in Ontario has discovered that lemon-scented geraniums are capable of absorbing and accumulating large amounts of heavy metals from soil. Laboratory tests found the plants were able to absorb 3,200 mg cadmium, 18,700 mg of lead, 6,400 mg of nickel, and 650 mg of copper in 1 kilogram of dry plant tissue in only two weeks.

Pteris vittata - "Ladder Brake Fern", is a hyper accumulator of arsenic in soils, plant tissue can take soil at 40 ppm of arsenic and the plant tissue can reach 7,526 ppm in the fronds in one field test, in laboratory tests the fronds can reach 22,630 ppm.

The fern *Pteris melanocaulon* is another hyper accumulator of copper and arsenic where it stores



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them in its leaves and stems.

The plants are harvested and then they can be economically processed to remove the elements. There are now several mining farms around the world from the Congo, to Albania and Indonesia are using these techniques to mine needed elements.

The plant known as *Poa annua* that many of us consider a weed is being developed and studied for use as a turfgrass. The Latin root *annua* suggest that it is an annual species. However, there are thousands of species that are actually a perennial in their growth cycle. Crop Science (2021).

We continue to learn almost daily more about the importance of microbes to grow healthy plants. Plants produce chemicals known as flavonoids that give flowers and fruits their color. However, in the soil it has been discovered that these chemicals provide a different service.

Flavonoids attract a certain species of bacteria that the plant wants on its root system. The study found that the enzyme flavone synthase 2 was very high in the roots of some fast-growing species like Maize. This enzyme makes certain molecules from the flavonoids that promote growth.

When they planted a poor growing species into soil where the fast-growing plants previously was grown, the plant grew much faster. However, if they sterilized the soil first then the plant grew poorly as before. Nature Plants (2021)

I will speculate that this effect may be one of the reasons why many food crops grow better with higher yields when grown on soil that previously had a multi-species cover crop. Many gardeners have observed that when they have lots of diversity of plants in their gardens they tend to grow better and have less issues. Perhaps this effect is a contributing factor.