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NEWS FROM THE WONDERFUL WORLD OF SOIL AND PLANTS

By John Ferguson

A recent finding published in the journal American Naturalist (2022) by a professor of entomology at Penn State, was triggered by the observations of an eight-year-old boy.

The boy found BB sized objects near an ant nest beneath a log in his backyard. The boy thought they were seeds but they turned out to be oak galls. This led to a investigation of a 3-way interaction between wasps whom create the galls, ants, and the plants.

The wasps cause the plants to produce the galls and grow a substance on the galls that is food for the ants. The ants then take the galls back to their nest where the baby wasps are protected from predators by the ants.

The researchers found that galls with caps were far more attractive to ants than the galls themselves. So, they analyzed the caps and they were full of healthy fatty acids that smelled like dead insects (ant food).

Many other plants produce seeds that have a covering that is food and attractive to ants, hence they use the ants to spread their seeds. It makes me wonder how many other interactions in nature that we have left to discover in God's creation.

A 30-year study from Kansas State University has found that introducing bison (Buffalos) doubles plant diversity in tall grass prairies. The plant communities were more resilient

to extreme drought that occurred in the last four decades! Cattle also helped increase diversity but not to the same extend as buffalo. Proceedings of the National Academy of Science (2022).

Several studies have shown that prairies and grasslands that are grazed by migratory animals like buffalo, sequester carbon in the soil creating rich valuable humus much faster than without animals.

A few years ago, I read a book that detailed many case studies from all over the world using regenerative agriculture with grazing animals to sequester carbon, enrich soils, and fight climate change.

Geotherapy- Innovative Methods of Soil Fertility Restoration, Carbon Sequestration, and Reversing CO_2 Increase, Edited by: Thomas Goreau, Ronal Larson, Joanna Campe, CRC Press, 2015, ISBN: 13:978-1-4665-9539-2

The National Center for Appropriate Technology (ATTRA Sustainable Agriculture) has a paper article titled, "**Managing Soils for Water: How Five Principles of Soil Health Support Water Infiltration and Storage"** that can be found at www.attra.ncat.org. A few edited highlights are below.

1) **Protect the soil surface** – this includes cover crops and mulch
- they hold the soil in place and prevent erosion and allows for greater infiltration

- they provide organic matter essential for soil structure and plant health

- mulch reduces evaporation leaving more water for plant use

- cover crops and mulch reduce soil temperatures which help microbes to earthworms work better, and leads to a functioning soil food web

- the soil is protected from raindrops hence there is better soil aggregation that allows air and water to enter the soil

- weed growth is suppressed

- habitat is provided for beneficial insects and pollinators

2) Minimize soil disturbance of all kinds

- both physical (tillage) and chemical (artificial fertilizers, pesticides, etc.) abuse of the soil and disrupt the soil food web.

- tillage over time burns organic matter out of the soil which degrades soil function and reduces air space, which then reduces water infiltration and storage, and reduces nutrient storage.

3) Plant diversity is essential

- healthy fertile soils that were built over time, has a large mix of species of plants

- the soil food web requires a mix of root exudates from a broad range of plants

- a large diversity of above ground plants leads to a large diversity of below ground beneficial microbes

- this increases water infiltration and reduces diseases in the soil, and increases nutrient cycling

4) **Continuous Live plant roots in the soil**

- live plants from grasses to forbs and wildflowers continuously provide carbon rich root exudates to feed the soil food web throughout the growing season and often into the dormant season

- nature does not like bare soil and if no desired plants are present, then she will quickly cover soil with plants known as weeds. Bare soil does not provide root exudates to feed the good microbes which starves the beneficial microbes

- good compost and composted (aged) native mulch can also protect the soil and help feed the microbial community

5) **Integrating Livestock**

- returning animals to the soil contributes to soil health from adding different biology back to the soil increasing species diversity of microbes

- grazing animals also convert high carbon residues into low carbon high nitrogen organic material which builds soil health

- the hooves of grazing animals press organic matter into the soil where it becomes valuable humus

- animals increase species diversity

- for every one percent increase in organic matter in the top six inches of soil allows it to hold an additional 10,800 liters (approximately 3,000 gallons) of water regardless of soil type!

Food for thought: The city of Houston and other municipalities send millions of cubic yards of organic material to our landfills each year. In the landfill they create massive amounts of greenhouse gasses, organic acids, and take up a lot of valuable storage space.

If 50% of this material could be composted and used in all the parks, road right aways as well as out yards and gardens then couple this with using modern biological methods of landscaping often referred to as organic. Then how much water would have infiltrated our soil and be stored during storm events like hurricane Harvey?

I would need some data but I suspect it would have reduced the flood waters from Harvey by 20-40% saving billions of dollars in damages, plus reduced greenhouse gasses from landfilling, saved valuable landfill space, reduced chemical pollution of our bayous and streams, and reduced erosion, reduce sedimentation of our bays and saved water due to reduce irrigation requirements in our landscapes.

Recycling of organic matter offers tremendous potential to solve many of our environmental problems.

The table below gives one an indication of the tremendous amount of water that can be stored in the soil by increasing organic matter.

Soil Organic Matter and Available Water Storage Capacity in Inches of Water per Foot of Soil
Source: Based on Hudson, 1994

Percent Soil OM	Sand Inches Water/ft. of soil	Gallons of Water Per acre		Silt Loam Inches Water/ft. of soil	Gallons of Water Per acre		Silt- Clay Loam Inches Water/ft. of soil	Gallons of Water Per acre
1	1.0	27,154		1.9	51,593		1.4	38,015
2	1.4	38,015		2.4	69,170		1.8	48,877
3	1.7	46,162		2.9	78,747		2.2	59,739
4	2.1	57,023		3.5	95,039		2.6	70,600
5	2.5	67,885		4.0	108,616		3.0	81,462