June Biological Farming Roundtable Notes

What: The Biological Farming Roundtable was held at the NutriSoil Production and Education Facility on Thursday the 25th of June 2015.

Why: The aim of the Biological Farming Roundtable is to use papers/articles written by leading biological thinkers to initiate discussion and to help farmers learn and apply the information on farm.

Who: This Roundtable discussion was based on the article: ***Sentinels of the Soil, Power of the Earthworm – Acres USA 2015***

Group Discussion – What the worm can do!

Burrowing, Tunnelling and Distributing

To move through the soil, worms swell and use muscles to make tunnels in the earth. Worms get into small cracks, then widen and move their way through.

These tunnels improve soil function through the following ways:

- Create channels for water to infiltrate
- Provide room for gases such as oxygen, carbon and nitrogen to move through the soil
- Line the soil with a broad range of available nutrients where plants have direct access
- Breakup hardpan and other compacted soils
- Line the soil with calcium for a liming effect
- Deposit plant residues to feed microbes

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- Provide highways for bacteria and fungi to be transported via the worm through the soil
- Make access tunnels for plant root penetration

Worms break down plant and animal residue by turning, churning and shredding. Residue from the top of the soil is driven down much deeper into the soil by the worm, feeding microbes deeper in the soil. Worms can break down crop residue.

Calcium

The worm excretes calcium via three methods.

1. Through their calciferous glands (these glands secrete a milky calcium liquid),
2. Via granules ejected akin to miniature limestone's (mostly mineral with calcium being the biggest component)
3. In their castings, which are high in available calcium.

Calcium distributed throughout the soil by the worm, works as a cementing action and cements soil aggregates together. This creates good soil structure, reduces erosion and increases the soils ability to absorb and hold water.

Primary, Secondary and Micronutrients

Castings/worm leachate are full of primary, secondary and micronutrients at ideal levels. They provide a full balanced food for the plants distributed at the plant root zone. This nutrient is available to the plant in the correct amount, when it needs it. A worm can produce about a tonne per acre of castings/year in good conditions.

Castings/leachate are high in phosphorous that is immediately available and recognisable to seedlings at germination, stimulating seedling and root growth.

Earthworm activity counteracts leaching by bringing up nutrients from deep in the soil and depositing them on the soil's surface as castings.

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Earthworms increase carbon sequestration - Carbon is the primary element in earthworm castings.

Making minerals available to the plant

The plant feeds the fungi and bacteria in exchange for nutrients through the process of photosynthesis.

Photosynthesis is when a plant uses sunlight, carbon dioxide (CO2) and water to create sugars. The plant uses 70% of these sugars for growth and then provides the other 30% to the microbes in exchange for nutrients.

Bacteria and fungi send enzymes to collect nutrients that the plant has asked for in the correct ratios. The worm then consumes the bacteria and fungi who have the nutrients, process these in their gut, and excrete plant available nutrients. **The worm is essential for this conversion process.**

The carbon, humic and fulvic acids in worm castings and leachate are also key chelators and can increase solubility of minerals by up to 70%, dissolving even the most difficult to dissolve minerals.

Balancing PH

Castings and leachate of a worm have a PH of 6.9 providing a liming or neutralising effect on the soil. Casting analysis shows that the product coming out of the back end of a worm is closer to neutral than what goes in the front end.

By passing soil and organic matter through their bodies, worms gradually balance the soils PH level.

Worms clean up chemical residues in the soil from herbicides and pesticides.

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Creates a balanced Nitrogen Cycle

Nitrogen in the castings/leachate is immediately available and recognisable to the plant and comes in a nitrate form.

In this form nitrogen becomes available to plants just as it is required, so supply and demand are in perfect balance. Some nitrate is converted to gaseous forms of nitrogen, this supplies compacted or water logged soil with badly needed oxygen (through a conversion process), and supplies the nitrogen fixing bacteria in this anaerobic environment with nitrogen. Any excess returns to the air as nitrogen gas. Some of the nitrogen will be leached to deeper levels of the soil and into the waterways, where it feeds other organisms. Here, nature creates balance.

High levels of ammonium based nitrogen fertilisers are highly leachable and the delicate system is disrupted. Excess nitrogen ends up in the soil organic matter or in drainage water. This leads to the pollution of our ground water and rivers, and all the health problems associated with that.

Growth Enhancer and Protector

Worm leachate and castings contain growth regulation properties including hormones, enzymes and plant promotants. These properties increase the plant's growing mechanisms as well as act as a plant defensive force, protecting plants from pests and diseases.

Supresses Weeds and Pests

Worms promote healthy soils where weeds are outcompeted by preferred species. Weeds are an indicator of an in balance in the soil.

Earthworms create soil conditions that discourage populations of soil organisms such as insects, nematodes and others that are harmful to plants.

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The Research

The mucus on the worm feeds fungi. Research has proven that the leachate of a worm increases mycorrhizal fungi by up to 70%. Earthworms also consume spores of mycorrhizal fungi and bacteria. These spores and microbes are deposited in the worm castings, deep in their burrows.

Worm leachate nearly doubles microbial mass and diversity.

The application of worm leachate increases yield and can be comparable yield to high input synthetic fertiliser systems.

The Worms Gut is a Microbe Factory

Worms derive their nutrition from bacteria and fungi. The microbes and fungi, consume decaying residue in the soil along with nutrients and are then eaten by the worm. The worm's gut processes the bacteria, fungal cells and carbon and concentrates them into mineral nutrients. The castings are the fertile mineral nutrients distributed at the root zone of plants.

Worms also eat residue, then the microbes and bacteria in their gut decompose the residue. This allows this residue to be distributed through the soil in the form of carbon.

Worms consume nitrogen fixing bacteria. This keeps nitrogen in the soil in an available source for the plant and reduces nitrogen gas being lost to the atmosphere.

Group Discussion - How do we help these worms get it done?

Acid soils are an earthworm's enemy. Ways to manage this are:

- Reduce synthetic fertiliser use such as Urea, Superphosphate, MAP and DAP which are highly acidic.

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- Feed the biology with a food source such as worm leachate, fish, humate, a well-made compost tea or extract, worm castings or compost.
- Add small amounts of lime to the soil with a biological food source to assist the lime to be made available to the plant and reduce lock up of other nutrients such as magnesium OR feed the biology which will in time bring your PH to its natural state.
- Graze grasses to keep bacteria alive and active for worms to feed on.
- Keep organic matter on the top of your soil to feed the microbes and keep soil temperatures from extreme weather conditions such as heat and frost e.g. slash pastures, retain stubble, spread manures, keep animals in cropping systems to spread manure, pasture cropping.
- Putting down a nematicide, pesticide, fungicide will kill the worms. Avoid high synthetic fertiliser use which may lead to the infestations of pests that will need to be treated. (The chemical treadmill or see a bug and kill it approach).
- Aim for minimum tillage. Tilling mangles earthworms and destroys their burrows.
- Pasture cropping- plant diversity, companion planting and 100% cover is an ideal environment for earthworms to thrive.
- Crop rotations to keep a check on pests and diseases which may require pesticide or fungicide treatment.

NPK fertilisers are only able to offer three nutrients, this leaves the plant deficient of many nutrients. Plants lacking in a broad range of secondary and micronutrients are susceptible to pest and diseases. Soils that are out of balance will also compensate by growing weeds, more herbicide may be necessary.

Synthetic nitrogen fertiliser is toxic due to its ammonia content and also indirectly acidifies the soil.

Overuse of herbicide will harm earthworm and microbial populations

Superphosphate applied at seeding reduces root growth and only an estimated 10% of this is available to the plant. The other 90% becomes locked up in the soil and leads to lock up of other nutrients.

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All bio-stimulants such as manure, fish etc. all need to go through the microbial conversion process to become available and recognisable to the plant.

Earthworm castings and leachate have been through this process in the gut of the worm. They are rich in soluble nitrogen as nitrate and soluble phosphorous as well as a broad base of primary, secondary and micronutrients in a plant available form.

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