



Urlar

BIODYNAMICS

Another amazing month... Besides Level 4 Lockdown



WHAT'S NEW

Urlar BD Area In Full Swing

Thanks for all who participated at Urlar 500 Day. Last year 500 was applied to the vineyard, after activating it in in the barrels. The old way!

Cow Pat Pit

The same day, while some of us were stirring the barrel to dynamize the water, other were turning and checking on the cow pat pit. Cow pat pit should be stirred often and never let to sit dry.



A chance to catch up

During the day, all the participants had a chance to catch up, exchange knowledge, practices, suggestion and the vision for the future of Wairarapa BD

SAVE THE DATE

UPCOMING EVENTS:

11-19 September
Organic Week Aotearoa

New Zealand's largest annual celebration of all things organic.

Thursday, 23 September
Spring Equinox

First Day Of Spring!!!

September (Day to be confirmed)
501 day @Urlar

Join the Urlar team in making the preparation 501

(Subject to lockdown levels)



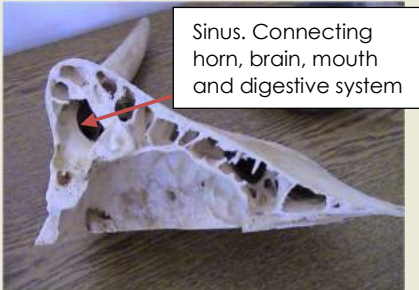
16th September 2021, 6:30 pm to 7:30 pm
Cultivating Conversations

Web-based meeting for members of Biodynamics New Zealand to discuss all things biodynamic.



Preparation 500

By Luca Fant



Why using numbers?

A bit of history

The number designation for biodynamics preparations is due to a series of multiple factors.

During the Third Reich (1933-45) the biodynamic preparations were forbidden in Germany, those farmers and researchers who were working with biodynamics decided to code the nine preparations, with "500" for horn manure, "501" for horn silica and so on, to avoid discovery.

But why 500?

Ehrenfried Pfeiffer, a pioneer of Biodynamic and Rudolf student, discovered that horn manure contains 500 million aerobic bacteria per gram. He named the preparation 500 and since number were adopted to also facilitate communication between different speaking countries.

The biodynamic preparation 500, also called horn manure, is the mostly known and commonly used biodynamic preparation. But what is it and why is it used?

The BD500 is made by collecting fresh cow manure, preferably from a lactating cow, which is then stuffed inside cow's horns. This is common knowledge across the biodynamic community.

But why horns? And why cow's horns?

From a scientific Biodynamic perspective, BD500 is mostly concerned and focused on bacteria and bacteria's products.

As Rudolf and Ehrenfried discovered around 100 years ago, **bacteria** are one of the **engines of life**. Bacteria are responsible for breaking down matter and transforming organic compounds into plant available nutrients, which can then be re-used by the plants. Not only, bacteria products, especially enzymes and protein chains, are the food of other microorganisms, like protozoa and nematodes, which in turn are the food for bigger organisms (worms for example). Worms are then the food of small animals that are the food of bigger animal and so on.

This network is called **the soil food web**, see figure in the next page, and it is the single **most important life network**. Without it, there will be no life! Hence why keeping the soil food web not just alive, but healthy and performing at its best, is crucial.

In nature, **bacteria** break down organic matter mostly in two environments, the **soil** and **animal gut**. Yes, even our gut.

The bacteria responsible for such complicated reactions are very present in the stomachs of ruminants; Especially in bovines, which have 4 stomachs (or a 4-compartment stomach) and their diet is mainly nitrogen rich vegetation.

Originally (and sometimes still done today) the cow manure, very rich in bacteria, was buried into sheaths of the cow stomachs, again very rich in bacteria. This practice was very dirty and unpleasant.

What biology studies have then discovered, is that cow's horns are connected to the intestine through a hollow channel (sinus) which pass through the brain, nose and mouth, thus horns contain the same bacteria as the gut of a horned ruminant.

R. Steiner considered the **horns to be a sensory organ** (a kind of skin) that is orientated inwards and forms an integral part of the digestive system. It is an **extension of the digestive system**; it forms a kind of closure of the cow's organism.

So why not use any other ruminant's horns?

For example, Goats are horned ruminants, and have a 4-compartment stomach or four stomachs as cows. So why not use goats' horns?

Due to their diet, goats eat mostly shrubs and bushes, the bacteria contents in the goats' digestive system and the gut's chemical composition are more aggressive to be able to break down more complex compounds. Goats' horns create a very hostile environment for most soil's beneficial bacteria.

The horn manure resulting from a goat horn will have different bacteria and different metabolic products that the one from cows.

Will this make the preparation ineffective? I do not think so. In my opinion the goat manure may need longer burial periods, and longer preparation times, as **goats' horns are very small**, and **goats' manure** are in the form of **semi-dried droppings**.

Additionally, goat horns are a part of the bone skull of the animal, and they will need to be sawn off before using them, again very impractical and unpleasant.

Lastly, **cow horns have about 80% more blood flow** than any other animals, even bulls. This will make for a very fertile substrate for bacteria to grow, again compared to the goat blood flow to the horns which is limited to the area just above the skull.

Cow's then graze in a completely different way than most ruminants. If you observe the cows grazing in a natural environment, you will notice that the cows rip off the sheaths from the crown of the plant and don't chew them off as other animals do (sheep, goats, horses, etc.) During this process the plant roots are pulled from the topsoil lifting the plant a bit. This type of grazing oxygenates the roots of the plants, the rhizomes and the bacteria nodules, which has an immediate positive effect for the grasses.

In addition, during this process, the cows **breathe in some soil** particles effectively **inoculating their guts and horns** (remember all is connected!!!) with the composting bacteria which are in the soil. Those and other gut's bacteria break down the food in the cow's guts and trade energy, proteins, etc. for a safe living environment. It is called a **symbiotic relationship**.

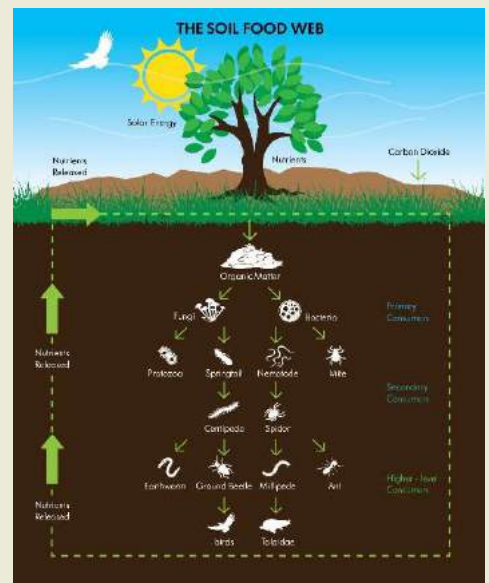
It then makes sense to use the cow's manure to grow and produce a soil biological enhancer, as the manure will naturally be the perfect substrate for the composting bacteria to propagate. The manure is already partially composted in a perfect (temperature, humidity, etc.) environment (the cow's guts). The cow's manure is already inoculated with the indigenous bacteria and already containing the enzymes needed to finish the composting (fermentation) process.

So why **lactating cow's manure** produce the best 500?

Again, this is bacteria-enzyme related. During the lactation process, a cow's **immune system** is running at its top. The milk secreted by the cows need to be full of antibodies, not to create a sterile environment, but to create an **antigen free environment** for the best chance at life for the offspring. Consequently, every organ of the lactating cow is working at its top conditions. The bacteria in the lactating cow's digestive system are quite different than a non-lactating cow. All the antibodies created by the cow's immune system and travelling through the cow's blood and lymphatic system, kill off most antigen even in the cow's guts. The result is a manure with a **higher concentration of composting bacteria and enzymes with less antigens**. As there are less antigens consuming important enzymes and nutrients, the wanted composting bacteria will thrive and create a **better, richer preparation**. There is even a lower possibility of antigens (spoiling bacteria in this case) taking over the preparation.

I think these are enough reasons why cows have been used to make the preparation 500. Still, I may have omitted one of the most important reason why **cows** were chosen. They are **simply the most common farmed animal**. So, cow manure and cow's horns were readily available to most farmers.

After all, one of the first rules of biodynamics is that the farm should be a closed entity. **Nothing in – nothing out!** Even the fertilizers should be made with our own farm products.



Symbiosis vs synergy

Although both terms refer to a system which is created by the need of a combined action between two or more isolated systems, a symbiosis is a relationship of mutual benefit, while a synergy behavior cannot be predicted.

For example dynamizing the water creates a synergetic environment, (the interactions between the bacteria, water and us, elevates the energy levels of the final preparation) but not a symbiosis.

During dynamization of the water, we give our energy (as stirring work) to the water. In this system we lose energy. It derives that it is not a symbiosis as the final system is not beneficial for us. That's of course in the short run.

Biota

Biota is the animal and plant life of a particular region, habitat, or geological period.

Soil Biota is the most important environment to keep alive and thriving. Without soil biota the soil rapidly dies becoming dirt. Dirt is simply just dead soil, with no life. A dead soil, with no life inside it, cannot support the growth of any life on top of it.

100% of the food we eat is directly or indirectly generated from the soil. It derives that if we kill the soil biota (i.e., using synthetic fertilizers or pesticides) we will slowly kill ourselves, as we destroy our food supply.

Interesting Fact

There are more microbes (like bacteria, archaea, and single cell eukaryotes) in a teaspoon of soil than there are people in the entire world. Are we really at the top of the food chain?



1. Termite 2. Red velvet mite 3. Pseudoscorpion 4. Springtail
5. Earthworm 6. Root tip 7. Nematode 8. Fungi 9. Protozoa 10. Bacteria

The horn stuffed with cow's manure are then buried in the ground. The **best time to bury** the horns is during a **descending moon last quarter day in fall**. It is then left underground for six months. During this period, the bacteria in the cow's manure slowly break it down. Very similar to a composting process.

So **why burying** the horns?

As we already know by now, the horns are the perfect substrate for the bacteria to grow. But if we just leave the horns outside in any environment, good chances are that the horn manure will just dry up, wash out or be colonized by unwanted microorganism. Remember, the cow's guts is one of the **perfect environments** for the bacteria to multiply? The other, of course, is the soil. But what is in the soil that makes a perfect environment for the bacteria?

Bacteria are very susceptible to temperature changes, light changes, humidity changes and attack by other biota. Under the ground, **temperature, light and humidity are quite stable, or any changes are subtle**. A good example of this stable environment used by humans can be seen in the ancient refrigerators which were simply holes in the ground. Burying the horned filled with manure and sealed with a cap of clay, in a very stable environment will give the best chances for the bacteria to ferment the manure.

But what does actually happen during these six months?

As we already know, 500 is a soil enhancer, a soil conditioner or a soil tonic. The purpose of the 500 is to improve the soil's physical qualities, its fertility and its mechanics.

Rudolf discovered that to achieve this we need to add what he refers as "**life forces**". Later discovered to be a **combination of bacteria (in spore or viable form), enzymes (produced by bacteria, fungi or other living organisms), hormone like compounds (compounds with phytohormone-like properties) and protein chains (food for the biota)**. Giannattasio, M. (2013) in "Microbiological Features and Bioactivity of a Fermented Manure Product (Preparation 500) Used in Biodynamic Agriculture", discovered that 500 is exactly that. A combination of bacteria, enzymes and hormone like compounds, with minor instances of antigens (Actinobacteria and Gammaproteobacteria). Enzymatic analyses on the 500 indicated a bioactive potential in the fertility and nutrient cycling, what is referred as life forces.

During the **six months under the ground**, the **bacteria metabolize (fermentation process) the cow manure** and produce a **combination of all the substances needed in a bio-stimulant**.

Again, the importance of having a **perfect substrate** associated with a **perfect environment** is vital to create the **best soil bio-stimulant**. The horn is the perfect substrate, the soil is the perfect environment that we can use to create a perfect synergy; the perfect scenario to produce the perfect preparation. Or is something missing?

Yes, even if the soil has very subtle changes during the year, it indeed still changes. In **summer the soil is usually drier and hotter than winter**, conditions that are **not ideal for the fermentation** of our horn manure. Hence why the manure is buried under the soil during the **winter months**. The **soil** is considerably more **humid and cooler than in summer**.

And what part is the moon playing in all of this?

The **moon** is the **only earth's natural satellite** and the closest celestial body to us. The moon influences on our life are well known and documented, from the **tides** to the **tidal braking** which may have been key to making Earth a livable planet by moderating the degree of wobble in Earth's axial tilt, which **led to a relatively stable climate** over billions of years in which life could flourish.

Electromagnetic radiation and/or the **gravitational pull of the moon** may trigger the **release of hormones which can stimulate life**. A study found that there is an 8 per cent increase in meal size at the time of the full moon relative to the new moon. Hospital admissions are higher as 3.6% during a full moon. Data from 140,000 births in New York City showed small but systematic variations in births over a period of 29.53 days - the length of the lunar cycle - with peak fertility in the last quarter.

So, during a **descending moon**, the **gravitational pull** of the moon is **stronger** than during an ascending moon, as the moon is closer to the earth. Burring the horns during what is considered the **most fertile period of the moon cycle**, gives the bacteria the best chance to thrive.

To recap, we have a substrate (horn manure) with mostly only beneficial bacteria, in a nearly perfect environment (soil), with the best condition for the beneficial bacteria to proliferate (during winter), buried at the best time (descending last quarter moon). We could not create better initial conditions to ferment a very powerful soil tonic.

But why do we need to wait six months?

A **bacteria life** cycle comprises of the **lag phase**, the **log or exponential phase**, the **stationary phase** and the **death phase**. The phases are strictly dictated from the environmental conditions.

During the lag phase, bacteria adjust to their environment. Spore-forming bacteria (sporulating) have a long lag phase when the spores germinate into a growing cell. Then if the environment conditions are favorable (enough nutrients, right temperature, enough humidity, etc.) the bacteria will go through what is called vegetative growth, during which it will rapidly multiply. Some bacteria can double in number in as low as 15 minutes. This phase, log phase, lasts as long as there are favourable environment conditions.

Once the environmental conditions start to become unfavorable, due to accumulating waste (enzymes, vitamins, proteins that for us is a treasure) and a lack of space, bacteria cannot maintain the clip of the log or exponential phase anymore.

Sporulating bacteria start then to produce **endospores**, which it is a **stripped-down, dormant form** to which the bacterium can reduce itself. Endospores are **extremely resistant** to heat and other harmful conditions and agents. Endospores **can be dormant for centuries** as the metabolic functions are basically halted, or cryptobiotic (dead). For this type of bacteria, the sporulating phase can be seen as the death phase.

Making the Best 500

Perfect food for the wanted bacteria:
Cow manure

Inoculated with only wanted bacteria:
Lactating cow manure

Inserted in the best substrate:
Cow's horns

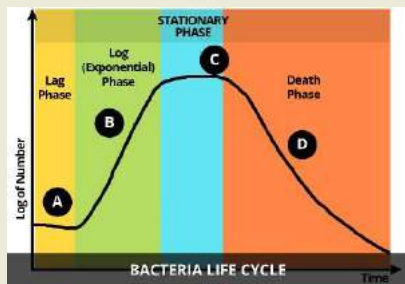
Buried in the perfect environment:
Under the soil

In the best fermenting conditions (temperature, light and humidity):
Fall to Spring

With the best initial conditions:
Descending moon, Fresh rich manure,

For the appropriate amount of time for a perfect fermentation:
6 Months

Best 500!!!



Using 500

Best environment for awakening and germination of the spores (lag phase):

**Warm water,
Chemical free environment**

Create the best environment for the exponential growth phase:

**Keep the water warm,
Usable energy (kinetic),
Dissolve oxygen in the
water,
add a bit of food (CPP)
Dynamization**

Starting a new log phase by providing more food and space for the bacteria:

Apply the preparation to the vineyard during the stationary phase

New spores generated in the vineyard. Inoculation of the soil.

Death of old generations of bacterial

Why is this so important for the 500 preparation?

If you remember from before, to have a soil bio-stimulant, we need to have a combination of enzymes, composting bacteria, hormone like substances and protein chains. Without any one of those components, our tonic will be missing one or more "life forces".

So, if we would apply the **manure itself to the soil**, we firstly would be **feeding a lot of unwanted living organisms**, like gram-negative bacteria (bacteria that cause infections including pneumonia, bloodstream infections, wound infections, and meningitis).

Secondly, we would be **missing a lot of enzymes, proteins and hormone-like compounds**.

Only a **part of the energy** stored in the manure will be **used by the beneficial bacteria**. Which then will mostly be eaten by other organisms in the soil biota, before they can actually produce all the "life forces" that are needed.

On the other hand, **burying the horn manure will produce** a dense, rich **compound full of** exactly what the soil needs to produce the perfect substrate to support plant life. Or full of **life forces**.

All the nutrients available have been consumed by the bacteria that we selected from a lactating cow's manure, and not by unwanted organisms. Due to the lack of food, the bacteria will have sporulated and be there waiting for favorable environment conditions to germinate and start the cycle again. No other living organism will consume them.

So, not only we have a powerful compound, but all the components inside are in a stable form. Which it means that the compound can be stored.

We can say that **we harnessed the energy of life into a stable, usable form**, which we can **use at our own convenience**.

It does sounds like **magic, or hocus- pocus...** It is **just science and biology!!**

What now? How do we use it?

As seen, the **soil biota** is like a **war zone**. **Limited resources** with billions of living organisms in as little as a gram of soil. How do we give the best chance to our live, dried-up bacteria, so they can keep on doing their work, and sustain life? If we apply the **500** in this status **directly to the soil**, in less than a second it would be **consumed by other biota**. Nematodes, prokaryotes, other bacteria, fungi, viruses, complex organisms, (just to name a few), will have a feast of our preparation. Just think that about only **0.1%** of any **organic matter** applied to a vineyard **end up being used by vines...**

First, we need to **re-activate the bacteria**, germinate the spore, get the bacteria over the vegetative state and into the log or exponential reproduction phase. **Only then** we can **apply it to the soil** hoping for a chance of the stimulant to have an impact.

So how we do that?

Easy, we just need to create the best favorable environmental conditions for the endospores to germinate and for the bacteria to start reproducing.

The bacteria we are focused to wake and reproduce in the preparation are called **mesophilic** or an organism that **grows best in moderate temperature**, neither too hot nor too cold, with an optimum growth range from 20 to 45 °C. The **best temperature for germinating mesophilic spores from the 500 is 37.5 °C**, very similar to our body temperature.

So, we need to create an environment that can easily reach 37.5 °C, keep the temperature constant and supply the endospores with a lot of energy and oxygen to germinate.

Having a constant range of temperature is optimum in order to germinate and multiply only wanted bacteria. Most **gram-negative bacteria** are psychrophilic, and they **die if exposed to temperature above 20 °C**, while **thermophilic and thermos bacteria die** in temperature **lower than 45 °C**. (Thermophilic bacteria includes most types of Bacteria that cause meningitis).

Hence, temperature is very important to germinate only the specimen of bacteria that we need, without risking germinating any antigens or pathogens.

Water has a very high specific heat capacity, which means that it can absorb a lot of energy with minimal temperature change. Vice versa, water **can lose a lot of energy with minimal temperature loss**. Water can also **store a lot of dissolved oxygen** (DO) gas (O₂) absorbed through aeration, which is readily available for organism to use it as it does not easily bound with the water molecules.

Lastly, **water** is a very easily dispersible medium, **easy to atomize and disperse in the fields (spraying)**.

Sounds perfect? Yes, that's exactly why water is used!

We just need to make sure the water has enough energy (temperature) to support the life of the bacteria during the extreme fast log phase. Stale water can have a very high level of entropy, which is thermal energy that cannot be converted into mechanical energy, basically energy that cannot be used anymore. This is defined as the chaotic state of a system. The higher the entropy, the more chaotic is a system. In an **orderly system**, the entropy levels are very low, meaning there can be **a lot of available energy to be used**.

So, the water needs to be "active" moving around, and order needs to be given to the water system.

The process used to keep the water energy level high is called dynamization. Or to give energy, make more dynamic. Even if the process seems to create more chaos, in reality the water molecules all align in the same direction, giving a strong order to the system, enabling the system to absorb energy (from a quantum physics prospective).

Traditionally, the water is stirred until a **vortex** is formed (which is the **order, all the water molecules are following the same direction**) and then the **vortex gets destroyed by stirring the other way**. This is the **chaos part**. The **water molecules hit each other's**, creating **high levels of kinetic energy** (mechanical energy), that gets **trapped into a very receptive system** (remember until few seconds ago, order was prevailing in the system, the entropy was low, and the system could absorb a lot of energy). **Generating chaos** by breaking the vortex, will **fast increase the enthalpy** (sum of a system's internal energy) **of the system, locking in the thermal energy**. Creating order again, by creating an opposite vortex, will restart the process form a higher energy level.

This process gives the water a very high final energy level, especially thermal energy, which will support the life of the bacteria. Every person that ever applied a 500 have noticed that the water stays at the set temperature for hours. That is exactly what we wanted to achieve with the dynamization process.

There is an added advantage of this process. The **water is agitated** a lot, **dissolving** even more **oxygen into it**, which bacteria will need.

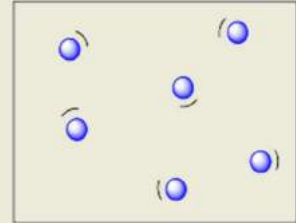
What is Dynamization?

Dynamize water means to restore all of its natural energy and its original structure.

To simulate the natural fall of water down a mountain.

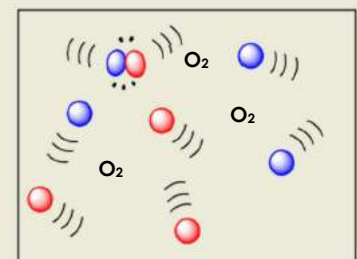
Stale water molecules have a very low energy point. A lot of the energy is lost in heat as the water stand still.

A lot of oxygen is lost as well.

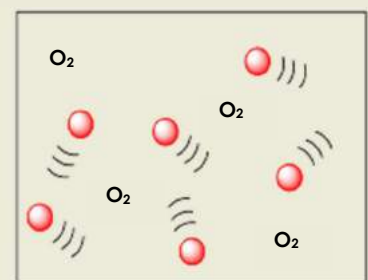


During the dynamization process, our human energy added to the system via the stirring is transformed in kinetic energy as the water molecules hit each other's.

As the water is aerated, a lot of oxygen gets dissolved in the system as well.



This created a system with a higher energetic level with more available dissolved oxygen.



As we are trying to awaken, germinate and multiply thousands of aerobic bacteria, our system needs to satisfy the bacteria biochemical oxygen demand (BOD) and the energy required to keep the system at a constant 37.5 °C. All of this will not be achievable in stale water. Dynamized water is crucial for the best 500.



One hour to stir One hour to apply

During the first hour the bacteria spores germinate, then the bacteria acclimatize with the environment, then they rapidly grow and reproduced. 1 generation every 20 minutes.

After the initial lag phase of 20 min, the bacteria will be at the 3rd generation after one hour, consumed most food sources and start to slow down the reproduction. That is the perfect moment to apply the preparation to the vineyard. The 3rd generation is very strong, with millions of bacteria. Waiting more time before moving the bacteria into a new environment to reproduce will start the death phase of the bacteria. The preparation will be not as strong or even dead if applied too late.

Why do we stir for one hour? And then we only have one hour to apply the preparation?

If you remember, the bacteria cycle is divided into four main phases. One lag phase, where the bacteria germinate and acclimatize with the environment, followed by a rapid growth phase (log phase). After that, when the environment becomes a bit more hostile, there is a stationary phase, followed by the death phase.

We **do not** want to **apply** the soil stimulant in any phases where the **bacteria are somewhat struggling**. We do not want to apply the preparation during the lag phase, the multiplication phase or the death phase.

So, we need to awaken the bacteria, nurse them until we can and when the bacteria start to be too many for the environment, we need to apply them in the vineyard. That is the moment where the bacteria are stronger, healthier and ready to take over a new environment and start a new log phase.

The bacteria we are dealing with, double in size (go through a generation) **every 20 minutes**, and after 6 generations tends to go back into a spore status.

The first 20 minutes is roughly the lag phase, in the next 40 minutes (in the first hour) the bacteria reach the third generation, which is considered to be the strongest. And after **three generations** our **water** starts to **become** quite **hostile**. Not many nutrients are left (hence why adding a bit of CPP toward the end of the stirring can be very beneficial) and the bacteria have by now produced a lot of "waste" (remember that's what we want!! Enzymes, protein, vitamins, etc.). **They want a fresh substrate**. And the **vineyard is just there full of organic matter** for them to **feed on and produce the waste we so desperately need!**

Once the preparation reaches the soil, the enzymes, bacteria, hormone like substances, etc. are quickly absorbed by the soil and soil biota. The bacteria start breaking down the organic matter giving off nitrates, exchangeable potassium, calcium oxides, and other compounds that can be used by other specific bacteria to close the cycles.

If we wait **more than one hour**, the bacteria will have probably **used all** of the **available resources**, **most** of them would have **died**, while **others** will be **turned into endospores** again.

If we apply the preparation at this stage, we will only be applying the perfect nutrient for other soil biota, as dead bacteria and spores are easily consumed by other organisms of the soil food web. All our efforts to make the perfect soil bio stimulant would be in vain.

To be effective, **preparation 500**, **must** be applied to a **very rich soil**. Rich in **organic matter**, to feed the bacteria in the 500 and **high in Cation Exchange Capacity (CEC)**, so the nutrient produced by the bacterial cycles can be stored and be available for the plant.

Preparation 500 do not increase neither the organic matter nor the CEC, hence why is so important to use the **biodynamic compost** with the preparations. **To create**, again, **the perfect environment for the microorganism**, the engine of life... Or simply the **life forces!**