NTS
Nutri-Tech Solutions®

Humus, Nitrogen and Microbe management
- The Humate Potential

By Graeme Sait

Accepting The Challenge

- Our only response to the **global warming challenge** has been to 'talk' about reducing CO_2 emissions.
- If we were to cut emissions by **100%** tomorrow morning, then in 200 years time we would drop down to the atmospheric CO_2 levels present in **1975.**
- These levels are too high and the oceans continue to **heat and acidify**.
- There are very few scientists that would agree that we have **200 years** left.
- So, is it **all over** bar the shouting?

Accepting The Challenge

- The answer is a resounding 'no!', but there are **5 key understandings.**

1. We cannot make new carbon – the planet's finite reserves move between the soil, living things, and the atmosphere, as part of the **carbon cycle.**

2. The lions share of this carbon is **stored in the soil** – in fact, there is almost double the amount found in the soil compared to that found in the atmosphere (1550 vs 800 gigatons).

3. **Two-thirds** of the carbon that used to be found in the soil, as humus, is now in the atmosphere. Organic matter levels have dropped from **5%** down to **1.5%** due to industrial agriculture.

Accepting The Challenge

4. This carbon lode from the soil is the **chief culprit** in thickening the blanket of greenhouse gasses which trap the heat, warm the oceans and dramatically impact our climate (**250 gigatons** from industry etc., **476 gigatons** from our soils).

5. The solution is to **put the carbon back**, from whence it came. When we build organic matter in our soils, we are effectively stepping into the carbon cycle and **sequestering** carbon that would have otherwise returned to the atmosphere.

Active vs Stable Carbon - Fungi To The Rescue

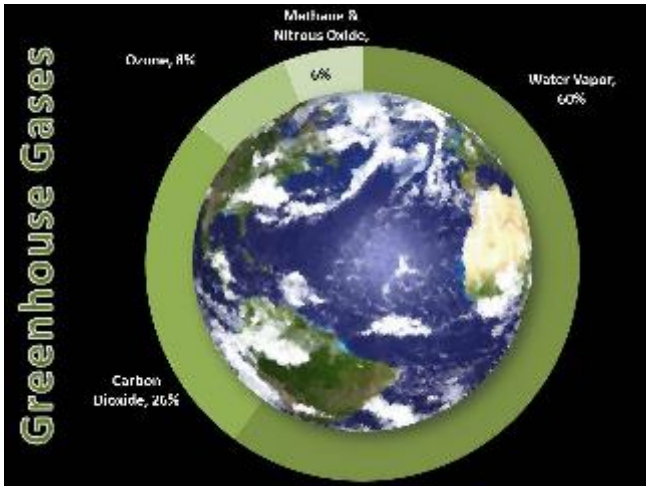
- '**Active' carbon** produced by bacteria (lawn clipping compost) has a short shelf life in the soil. It oxidises and returns to the atmosphere as CO_2 within 12 months.
- **Stable humus** is manufactured by fungi through creating a stable bond between clay and humus colloids.
- This form of carbon remains in our soils (and out of the atmosphere) for at least **35 years**.
- The sad story relates to the **disastrous loss** of cellulose digesting fungi from our farming soils.
- For example, there are just **10%** of **mycorrhizal** fungi remaining in our soils.

Humus Management – The Nitrogen Link

2. Nitrogen Mismanagement – Improving the management of the most abundant mineral in the plant is a wonderful example of the win/win potential of regenerative agriculture.

Agriculture contribute **80%** of Nitrous oxide to the greenhouse blanket.

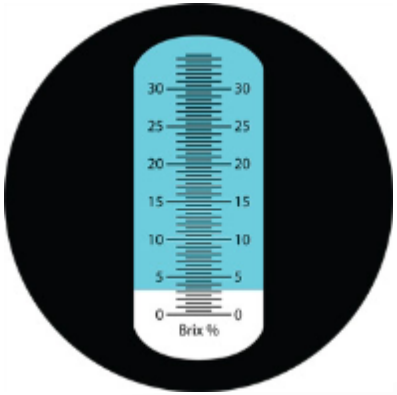
Nitrogen mismanagement is also a major root cause of **humus loss.**



N and Sustainability

- Excess N burns out organic carbon & contributes to the "**Greenhouse Effect**".
- It comprises the smallest percentage of the three greenhouse gases, but it is **310 times** more potent than CO2.
- Nitrates (NO_3^-) **contaminate** waterways, groundwater and drinking water.
- NO_3^- removes O_2 from the blood and are proven **carcinogens**.

- Excess nitrate in plants encourages **pest & diseases** to “clean up the garbage”.
- The **refractometer** often provides a guideline of the mismanagement of nitrogen.
- It is not possible to raise **brix levels** in plants with excess nitrates,
  as plant nutrients are diluted to compensate for high nitrate salts.
- The **nitrogen meter** is an invaluable tool to ensure optimum nitrogen management.



Accessing the ‘Free Gift’

- Currently N losses account for up to **50%** of applied N.
- Each hectare already has the equivalent of over **74,000 T** of N in the atmosphere (*> 5,000 truckloads of urea!*)
- We were supposed to get a large percentage of our nitrogen from the atmosphere.
- Our access to the ‘free gift’ is affected by several factors.

The Recipe for Free Nitrogen

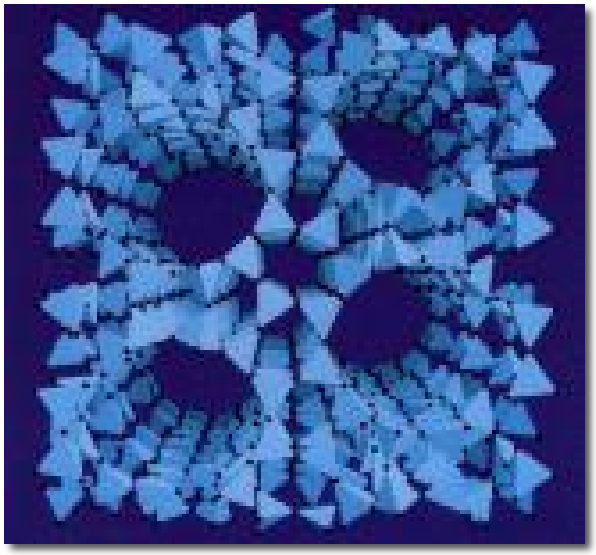
Natural N fixation – commercial inputs can be reduced if conditions are created to enable access to free nitrogen from the atmosphere. Try compost teas, Nutri-Life Micro-Force™, Bio-N™ and Bio-Plex™.

- A good **calcium/magnesium** ratio (oxygen)
- An adequate supply of soluble **phosphate** (ATP)
- Soluble **iron** (humic acid)
- **Molybdenum** (part of the nitrogenase enzyme)
- **Cobalt** (mothers milk for nitrogen fixers)

Urea Stabilisation

ZEOLITE:

- Zeolite is a **permanent** addition to the soil and increases its water and nutrient holding capacity.
- These crystals have a **honeycomb** structure with a remarkable surface area.
- They represent a prefect environment of nooks and crannies for **beneficial microbes** seeking solace in a dog-eat-dog world.
- There are two principle pore spaces in zeolite. One of them is the exact size of the **ammonium ion**. The other is the identical size of the potassium ion.
- Zeolite is the ever lasting **storage system** for N and K, moisture and microbes.



Urea Stabilisation

HUMIC ACID:

- Urea and Humic Acid are **perfect partners** with a rare compatibility. Together they create a stable **urea humate**.
- There is less volatisation and **less leaching** due to a lower conversion rate to nitrate nitrogen.
- Humic Acid should be used at a ratio of **1:20 (5%)** – i.e. for every 100 kg of urea, use 5 kg of **NTS Soluble Humate Granules™**.
- Humic acid provides **multiple benefits**. It is a microbial food source, a root stimulant and a soil conditioner. It is also a powerful chelating agent.

Urea as a Foliar Spray

- The single most efficient application technique for nitrogen is the use of urea as a foliar spray.
- Nitrogen en route to plant protein, undergoes **an energy-intensive** (10% of energy) conversion to amines, then amino acids, then protein.
- Urea begins life as an **amine** but is rapidly converted to ammonium nitrogen in the soil. Foliar urea enters the plant as an amine and is much more easily converted to **protein**.
- Foliar urea should always be combined with humic acid to **buffer and magnify**.
- A 10 kg urea foliar can equal 6 x that amount when applied to the soil

The Nine Eight Humus Building Hints

1. **Plant cocktail cover crops** – we now understand that the combination of five plant families in a blend, sponsors the release of phenolic compounds into the soil. These antioxidants spark beneficial soil-life.

- **Soil structure** changes, humus creation hastens, and **soil-life** thrives.
- The **five families** include: grasses, cereals, brassicas, legumes and chenopods.
- **Chenopods** and **brassicas** should only make up 1 - 5% of the blend, as they release chemicals that dissuade friendly fungi.

The Top Nine Humus Building Hints

2. Discover humates – humic acid is the most powerful promoter of the beneficial humus building fungi that are missing in most soils. Humates also sponsor **crumb structure** that can help reclaim the humus building apparatus of your soil.

3. Embrace compost – compost provides vast diversity and numbers of beneficial organisms to reclaim humus building capacity. There can be **5 billion** organisms in a teaspoon of compost, involving over **30,000** different species. Compost increases soil carbon by many times more than the carbon it contains.

The Top Nine Humus Building Hints

4. Minimise tillage – fungi do not favour the intrusion of cold steel. In fact, tillage slices and dices beneficial fungi. Every time we open our soil, we oxidise carbon and the negative impact is **quadrupled** in the wet.

- The major issue with no-till farming is that it involves **glyphosate**, amongst the most toxic chemicals ever applied to our soils.
- When this chemical is inevitably banned, roller crimpers, cover crops, and alternatives will come to the fore. **Human initiative** always delivers.

Reducing The Damage

- **Glyphosate** takes at least **6 months** to biodegrade in the soil, but then it becomes AMPA, a more damaging and persistent chemical (11 years minimum).
- There is a strategy to make glyphosate **less damaging**.
- It involves the following trio:

1. **Combine Soluble Fulvic Acid Powder** with glyphosate at the rate of 150 grams per hectare. The 1400 CEC fulvic absorbs the glyphosate, magnifies its uptake, and speeds it's decomposition (the honeypot effect).
2. **Reduce the pH** of the diluted herbicide **down to 2.9** with citric acid. This can immediately reduce the herbicide requirement by 30%.
3. **Add a sticker/penetrant** (like Cloak Spray Oil™) to increase efficiency.

- These products have been combined in a product called, **Herbi-Safe**, which is applied at 1L per hectare.

The Top Nine Humus Building Hints

5. Bring back your earth worms – Earthworms are missing in most soils, and there is a price to pay for this loss.

- Earthworms create humus **4 times** more rapidly than standard decomposition.
- They also produce a **fertiliser** from their rear ends, featuring 10 times more potassium, 7 times more nitrogen, 5 times more phosphorus, 3 times more magnesium, and 150% more calcium.
- If you can achieve the holy grail of **25** earthworms per shovelful, they will produce **300 tonnes** of earthworm castings per hectare annually.
- Earthworms also **incubate** a unique group of beneficial organisms that will be lacking in your soil, if the earthworms have gone.

The Top Nine Humus Building Hints

6. Don't burn down your cover crop – a herbicide burn down results in losses of the three key nutrients that can become gasses - carbon, nitrogen, and sulphur. It is a much better strategy to work the cover crop into the **A horizon** (the top few inches of your soil).

7. Include legumes wherever possible – legumes, like clover, tend to feed fungi. These creatures generate the larger aggregates that create **crumb structure** (better infiltration and gas exchange). The clovers under your cereal crops also deliver nitrogen and they release acid exudates to prize apart calcium and phosphorus (the two most important minerals for **photosynthesis**).

8. Enhance stubble digestion – In a living soil, residues should be fully decomposed within 6 weeks.

- If this is not happening, then you need some **help**.
- **Trichoderma** is a great multi-function option to speed stubble breakdown and associated humus formation. It also provides disease protection, root stimulation and phosphate solubilisation.
- **Fungal-dominated** compost teas are another option.
- In all cases the inoculums should be combined with **humic acid** (the lunch box approach).

9. Provide oxygen for your humus builders – oxygen is the single most important element for crop vigour and resilience.

- Management of **gas exchange** is a key role in crop production.
- The calcium to magnesium ratio governs the **breathing** of the soil.
- **Gypsum** is of great value in tight, closed soils.
- Micronised liquid gypsum can be used to impact the immediate root zone, via **liquid injection,** in heavier, broad acre soils.
- Fungi create **aggregates** to improve oxygen flow.
- Interplanting **legumes,** stimulates fungal crumb structure.

Countering the Methane Menace

- **Humic acid** may well prove the most effective tool for management of methane and nitrous oxide emissions
- In another **win/win scenario** humic acid stimulates soil life, increases resilience and yield, improves soil structure and increases mineral uptake
- However, in a study published in "**Frontiers in Microbiology**" in April 2020 humates were shown to be major players in countering greenhouse gases
- The study entitled "**Humic Substances Mediate Anaerobic Methane Oxidation**" demonstrated that these redox-active organic molecules with considerable electron-transferring capacity could reduce both methane and associated nitrous oxide

9 Hot Tips to Profit from Humates

1. **Young plants** are more responsive to both humic and fulvic acid. Younger tissues have more active transport mechanisms to move nutrients to sites of metabolic activity. **Foliar application** is most successful is this context.

2. **Humates** are excellent **brix-builders** – enhanced carbohydrate production can be detected with a refractometer within 24 – 48 hours (increased quality and yield).

3. A **combination** of humic and fulvic acid has been shown to be most effective for promoting **root growth**.

4. It may take up to **three applications** of soluble humates to achieve sufficient concentration in the roots to allow 20 – 30% of the humic acid to be transported through the shoots and leaves. i.e. You will always see **root growth** before shoot growth when top dressing humates.

Microbe Management – 9 Hot Tips to Profit from Humates

5. Humates can be used to lower **nitrate levels** or prevent the accumulation of nitrate in plants with obvious stock health benefits. In this situation humates also increase **potassium uptake** which is normally inhibited by excess nitrates.

RECIPE FOR NITRATE REDUCTION:
2% Magnesium sulfate (2 kg per 100 L)
150 g Sodium Molybdate
150 g Fulvic Acid Powder

6. If **carbon sequestration** is to be a new income stream in agriculture, then humates are a major tool. **Humates** are the most profound promotant of the creatures that build stable carbon in the soil (cellulose-digesting fungi).

Microbe Management – 9 Hot Tips to Profit from Humates

7. Don't discard the insoluble sludge (**15%**) when dissolving **Soluble Humate Granules** as it is the sponge-like, mineral-dense humin fraction which is an excellent fertility builder.

8. Humic acid is a powerhouse tool for **drought resistance.** The large surface area and internal electrical charges help hold water in the root zone. Humates serve as sponges which can hold **7 times** their volume in water. That stored water also facilitates nutrient transfer. i.e. potassium deficiencies in droughts.

9. The combination of **humic acid** with **liquid lime** liberates CO_2 from calcium carbonate providing a **photosynthetic boost.**

Using Humates to Improve Soil Structure

- Beneficial soil organisms lack the **photosynthetic** apparatus to capture energy from the sun, so they rely upon residual carbon compounds in the soil for their energy source. **Fulvic acid** is the most powerful known stimulant for beneficial bacteria, who release sticky polysaccharides that create mini aggregates (**soil crumbs**).
- Humic acid is the most powerful known fungal promotant. **Fungi** bunch together in mini aggregates and create a larger particle.
- This "**crumb structure**" is the most desirable of all soil structures. There are no hard pans and the plant roots can move freely in this naturally friable soil. Oxygen can readily enter and there is no "**puddling**" (and associated loss of nitrogen).

The Effects of Humates on Soil Fertility

- Humic and fulvic acids react with metals and clay minerals in the soil to form **organo-metal** and **organo-clay** complexes.
- These reactions **modify** the permeability, porosity, water retaining capacity, absorption characteristics, surface area and cation exchange reactions.
- They also affect the degradation and the **decomposition** of rock minerals including rock phosphate, lime and gypsum and the **flocculating** capacity of calcium.

- Humic acid can break up clay soils through its **dissolving effect** on clay minerals. Humic acid bonds onto the surface of clay platelets while **fulvic acid** is small enough to penetrate the spaces between the platelets and complex the minerals held within.

Humic Substances & Soil Microbes

- **Soil enzymes** can be stabilised and inactivated by humates. Pathogens often release enzymes to break down the plant's **defense system**. These enzymes can bind to humates and as a result the pathogens are unable to invade potential host plants.
- **Soil temperature** and water **evaporation rates** are stabilised by humates. The insulating properties of humates helps maintain soil temperature uniformity. This is important in cold spells and heat waves and serves to **support soil life**.
- Humates also regulate the **membrane permeability** of microorganisms, allowing them to utilise nutrients more effectively. The complexing effect of humates on trace minerals also increases their **availability** to microbes.
- Humates promote the production of plant **root exudates**, which provide a food source for microbes.

2. Humates

NTS Soluble Humate Granules

- Humates increase the **permeability** of the cell membrane (called “cell sensitisation”) to allow a **30** to **34%** increase in nutrient uptake.
- They are also the most powerful natural **chelating agents**, further magnifying the performance of applied and existing soil minerals.
- Both humic and fulvic acid share this **capacity to magnify** but fulvic acid is generally preferred for use with foliars while humic acid is used with fertilisers in the soil.
- There is a vast difference between **leonardite-derived** humates v’s those derived from lignite. All Australian and NZ humates are lignites.

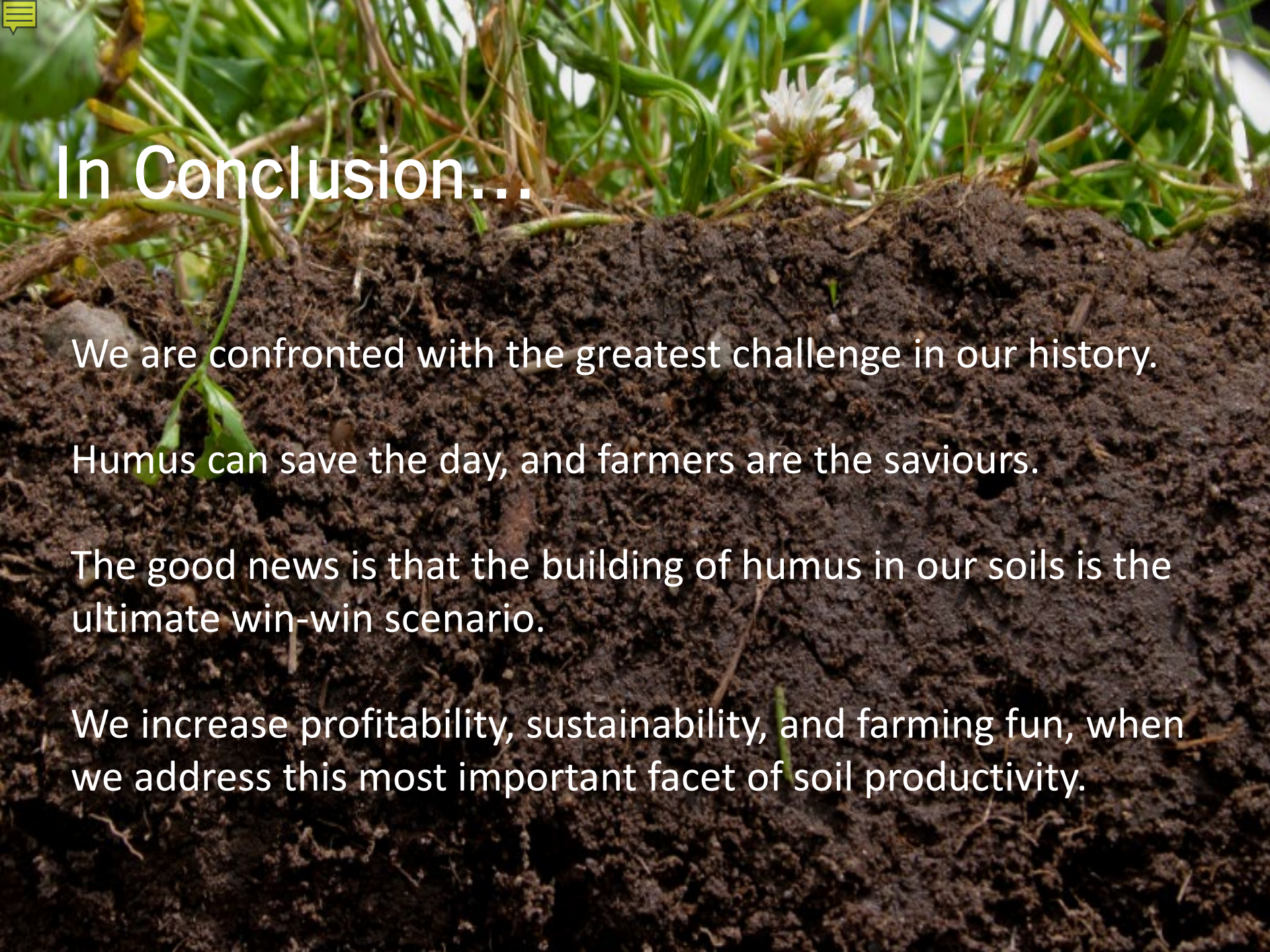
Fulvic Acid – More Than a Foliar

- Promotes root growth
- Dissolves minerals
- Prolongs production
- Provides growth promotion
- Serves as a ‘second sun’
- Detoxifies pollutants
- Magnifies nutrient uptake
- Improves moisture retention
- Stimulates bacteria
- A powerful electrolyte (capable of facilitating electrical reactions)

2. Humates

The Fulvic Phenomenon

- Fulvic acid is **compatible** with everything and can be combined with anything to magnify uptake by one third.
- This could include **glyphosate**, phosphorous acid, trace minerals etc.
- Fulvic acid combined with calcium nitrate creates a **calcium fulvate** – one of the most inexpensive, yet effective calcium delivery tools.
- Fulvic acid can also be used at higher rates to **neutralise chemical residues** and heavy metals. The result can be profound.
- Trial **30 grams** of fulvic acid applied to **100 square metres** of soil and observe the results.



In Conclusion…

We are confronted with the greatest challenge in our history.

Humus can save the day, and farmers are the saviours.

The good news is that the building of humus in our soils is the ultimate win-win scenario.

We increase profitability, sustainability, and farming fun, when we address this most important facet of soil productivity.