



Research, Validation and Commercialization of Technologies

**Part D-3: Plausible Scientific Evidence of Supreme(AG)TM with
Nutri-MasticTM as a Mulch, Soil Amendment, Natural Fertilizer,
and More**
Rev.6-13Jan26-ifus

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As a brief reminder, the IFUS Scientific Team is challenged with finding plausible explanations as to the reported efficacy of SupremeAGTM with Nutri-MasticTM, and NOT attempting to create science to justify the use of this IFUS Product (or any other IFUS Product line). The intent is to provide guidance on

how to best apply this Product Line for any given respective application, such that the efficacy of SupremeAG™ with Nutri-Mastic™ creates desired performance outcomes. As we say, Input / Output.

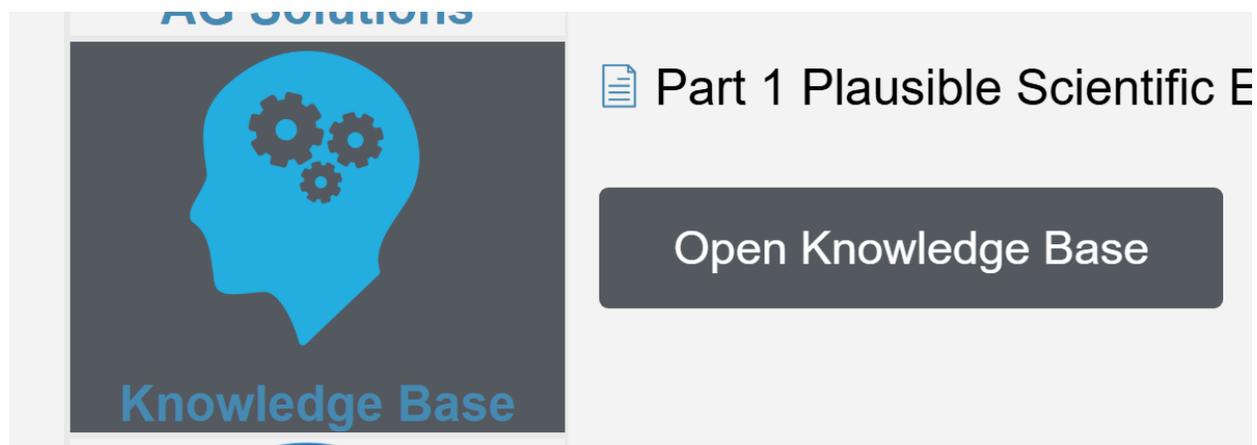
Hence, the science being explored is simply to offer plausible explanations as to why SupremeAG™ with Nutri-Mastic™ is being reported to produce desired Plant Performance Outcomes.

IFUS Part D-3: Microbial Biome

IFUS contends that based on observations and reports of successful application of SupremeAG™ with Nutri-Mastic™ (as well as observations made by the SUAREC Scientific Team on initial testing on Cruciferous vegetables; e.g., cabbage, etc.), both a level of efficacy (and limits) of the product (when applied as a technology in consideration of Best Gardening Practices for the respective plant, tree, and/or shrub) was advanced and even established.

Photographic evidence, qualitative measurement and analysis, and a comprehensive review of scientific studies (conducted and published with no affiliation to IFUS) offer plausible evidence in support of the efficacy of SupremeAG™ with Nutri-Mastic™. This evidence has been offered in a series of previous uploaded White Papers to the IFUS Website.

You can find these White Papers at [Nutri-Mastic™: Discover Better Health - Impact Fusion](https://www.impactfusionbrands.com/Nutri-Mastic™: Discover Better Health - Impact Fusion) <https://www.impactfusionbrands.com/>
<https://www.impactfusionbrands.com/knowledge-base/>



AG SOLUTIONS

Knowledge Base

Part 1 Plausible Scientific E

Open Knowledge Base

We begin: The complexity of the microbial genome in Sugarcane Bagasse is well-established. **Furthermore, this "genome" is part of a complex (at the least) group of microbial biomes that make up an intricate, natural biosphere of actions, interactions, and relationships that for the most part remained completely NOT understood by scientists to this day.** This is evidenced by “A snapshot of microbial diversity and function in an undisturbed sugarcane bagasse pile.” (Leigh Gebbie, et.al, BMC Biotechnol. 2020 Feb 28;20:12. doi: 10.1186/s12896-020-00609-y). Please note the intentional use of the word "snapshot" by the authors of the aforementioned paper, as for the most part, throughout the scientific world we have nothing but "snapshots."

To coin a phrase from the movie "I.Q.", the lines transpire in this manner:

Edward: "Your Albert Einstein. $E=mc(2)$."

Einstein: "I hope so!"

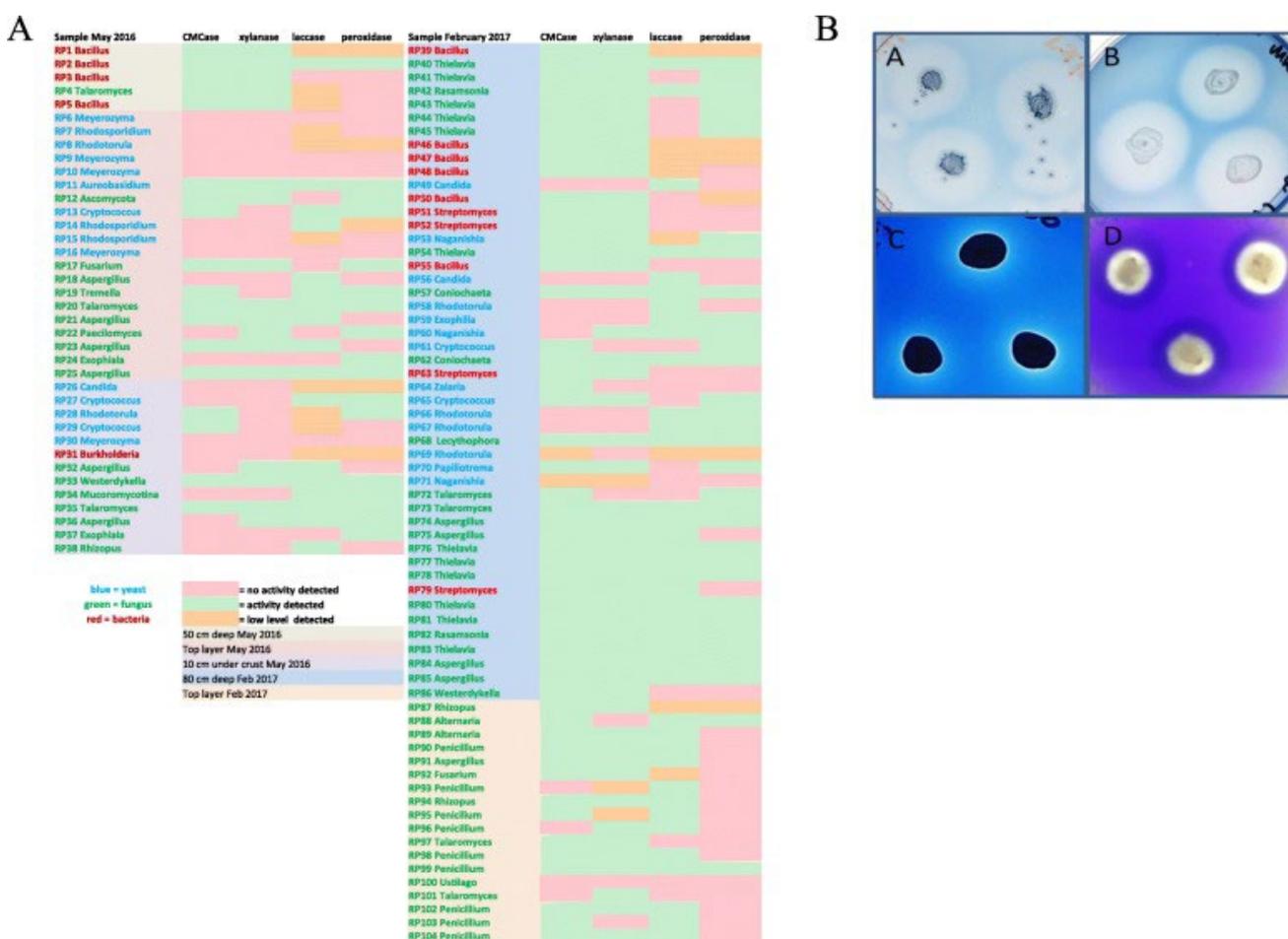
Therewithin lay our quandary in that many are asking for absolutes. The caveat is that in most cases we get a glimpse within a given moment in time...and NOTHING more. And, where this glimpse might reveal a portion of a given action, the best of our scientific methods can capture a limited portion of that action. Typically, additional studies are required to gather a glimpse of other aspects of the complete action, not to mention the interactions and relationships to other metabolic pathways or functions.

Hence, the search for scientific truth is on-going. Furthermore, whatever we claim that is revealed, discovered, and/or understood is best expressed as "plausible", as this is a significantly more correct statement over "we know."

Now that we have digressed for bit (albeit to establish a worthy distinction), we return to the study completed by Leigh Gebbie, et.al. discussing the microbial genome of Sugarcane Bagasse.

The study states: “The variety of species that was found and that are known for biomass degradation shows that the bagasse pile was a valuable selective environment for the identification of new microbes and enzymes with biotechnological potential. In particular, lignin-modifying activities have not been reported previously for many of the species that were identified, suggesting future studies are warranted.” (See Fig. 2)

Fig. 2.



"Screening of bagasse microbes for biomass-degrading enzymes. **a** The bacteria, yeast and filamentous fungi (RP1-RP103) isolated from different positions in the pile were screened for cellulase, xylanase, laccase and peroxidase on carboxy-methyl cellulose with trypan blue dye, azo-xylan, remazol brilliant blue and azure B containing agar plates, respectively. Activity was scored as positive or not based on clearance zones around the colonies. Low activity indicates a very minor clearance zone that took longer than 7 days to become visible. Examples of each assay are shown in **b**."

Hence, there exists plausible evidence of the presence of a broad array of beneficial microorganisms in Sugarcane Bagasse. Furthermore, the visible presence of White Rot and Brown Rot Fungi, when overlaid with the incredibly accelerated decomposition of the Sugarcane Bagasse fiber found in SupremeAG™ with Nutri-Mastic™, provides qualitative data that supports IFUS' claim that SupremeAG™ is high in Humic Substance. This accelerated degradation and depolymerization of lignin is believed to be driven by the addition of Nutri-Mastic™ and Carob to the Sugarcane Bagasse formulated, then processed into SupremeAG™.

Additionally, the IFUS Scientific Team finds evidence of the degradation and depolymerization of lignin when opening bags of SupremeAG™ with Nutri-Mastic™ (Picture 3). Product prepared and stored in SuperSaks for about 3-months, revealed active White Rot Fungi per the picture below taken at the IFUS Test Farm in SE Louisiana (about 15.5 miles SSW of NOLA).

Picture 3:



Additionally, in the same bag of SupremeAG™ with Nutri-Mastic™ (again aged, then bagged for 3-months), it was noted that when compared to SuperSaks

containing aged material that had been bagged for 6-months, that the material in the 3-month-old SuperSaks presented a different profile in structure and texture; that is, the material in 3-month-old SuperSak was less degraded (See Picture 4):

Picture 4: Note White Rot Fungi on Right Hand Side of Bag



This is supported when SGP+™ is aged, then transformed into SupremeAG™ with Nutri-Mastic™. The picture below clearly shows the presence of White Rot Fungi actively degrading the SB fiber.



As SupremeAG™ with Nutri-Mastic™ is made from SGP+™ with Nutri-Mastic™, we consider 2000-lb compressed bales 6-months after production. Unlike untreated bagasse (or hay) compressed into bales, SGP+™ bales begin to collapse with darkened water produced (an indication of lignin depolymerization by microbes naturally occurring in the Sugarcane Bagasse). These bales become unusable for optimum supplementation of Bovine Ration Management.

However, when stored and aged in the IFUS' Proprietary method, these once compressed bales begin to transform into SupremeAG™ as indicated by the bales collapsing (as shown in Pic 3-1 and 3-2):

Pic 3-1:



The science tells us that, “Under anaerobic conditions, major bacterial decomposition occurs, leading to the formation of black or dark grey colored wastewater [30],” Abdoul Wahab Nouhou Moussa, et.al., “Critical State of the Art of Sugarcane Industry Wastewater Treatment Technologies and Perspectives for Sustainability,” *Membranes* (Basel). 2023 Jul 31;13(8):709. doi: 10.3390/membranes13080709

Hence, based on the science, we conclude that water is produced from lignin degradation and depolymerization. This is why 2000-lb compressed bales of SupremeAG™ with Nutri-Mastic™ generate puddles of water (See Picture 3.1 above) until transformed into grey, dry powder as illustrated below:

Pic 4-1:



The intention of this initial discussion is to provide supportive evidence to the IFUS contention that it has discovered how to add natural ingredients to Sugarcane Bagasse and process the formulation in a manner that produces an immediate exothermic to endothermic shift (roughly 145 degrees F to 94 degrees F). This process results in the creation of roughly 2000-lb structurally intact, compressed bales (with virtually all water squeezed out) that stand on their own and can be safely stacked. Within a few months, these once structurally intact bales (which have continued to cool to roughly 84 degrees F) produce non-sulfur smelling effluent (black water) and begin to collapse (i.e., lose their structural integrity). Under

normal circumstance, untreated SB in this time would increase in heat content...not cool.

All science that has been reviewed to date offers the same plausible explanation as to what is happening...that being, the lignin in the Sugarcane Bagasse is being both degraded and depolymerized (without the addition of harsh, synthetic chemicals or steam processing or any other man-made intervention).

Rather, it would seem plausible that the complex natural microbial biomes existing within a complex, natural microbial biosphere within the Sugarcane Bagasse is being supported both by the formulation and processing to create SGP+™ and SupremeAG™...both of which appear to be tapping into the "Holy Grail of energy and nutrition" contained within the once recalcitrant lignin...and now being made available to nourish plants and animals in an eco-friendly and cost-effective manner.

This plausibly includes an array of phytochemicals (to include critical phyto-hormones and proteogenic amino acids, minerals, vitamins, and water) placed in the proper place, in the proper form, and at the proper time such that plant and animal performance is enhanced.

Once more, this CANNOT be invented. It was simply discovered.

INTERPLAY BETWEEN IONIC MINERALS AND HUMIC SUBSTANCES

We continue with a focus on ionic minerals and Humic Substances by considering a study performed by Nabi, F., et.al., "Structure-Based Function of Humic Acid in Abiotic Stress Alleviation in Plants: A Review. (Plants 2025, 14, 1916.<https://doi.org/10.3390/plants14131916>)

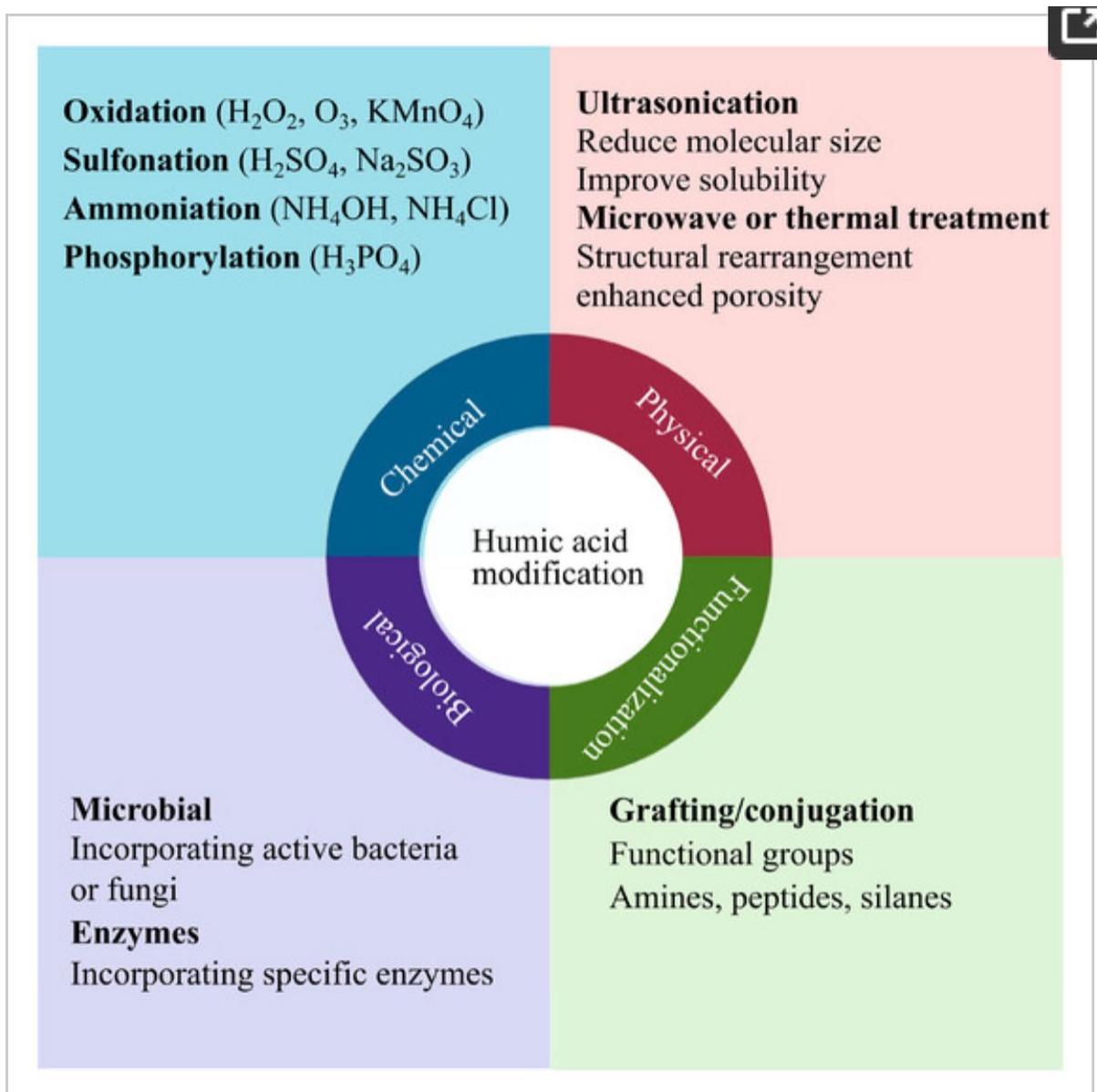
This study focuses on one component within Humic Substances, yet establishes a vital point:

"7. Conclusions: **Humic acids is a complex, multifunctional macromolecule that plays a pivotal role in improving soil physicochemical properties, promoting plant growth, and mitigating abiotic stress.** This review provides a comprehensive overview of HA's structural features and its physiological and biochemical mechanisms supporting plant health and resilience. Emerging surface modification strategies targeting key functional groups involved in ROS scavenging, nutrient chelation, and hormonal signaling offer promising routes to enhance HA's bioefficacy under stress conditions. Such advances have the potential to contribute significantly to sustainable and precision agriculture. While modified forms of HA, including nano-scale variants, show promise for

enhanced functionality, their environmental and biosafety implications require careful consideration. **Further systematic studies are essential to evaluate their long-term effects on soil ecosystems, non-target organisms, and human health before broad agricultural application.**" (See Figure 5)

Note: SupremeAG™ is not a modified form of HA, but a seemingly natural result of "Nature": being able to take "Her" course. This does not exclude the beneficial nature of both natural and synthetic Humic Substance as shown in Figure 5.

Figure 5. Categories and mechanisms of humic acid modification to enhance plant stress alleviation.



"Humic acid can be biologically modified using specific microbes or enzymes to

introduce or increase functional groups (e.g., carboxyl, hydroxyl), improve molecular complexity, and promote a more reactive structure, thereby enhancing its overall functionality and bioactivity [110]. Microorganisms such as bacteria and fungi can metabolize and transform HA, altering its molecular composition and increasing the abundance of functional groups like carboxyl, hydroxyl, and phenolic moieties. This microbial action can improve HA solubility, nutrient-binding capacity, and interaction with plant roots [111]. Enzymes such as lignin peroxidases and laccases (often produced by these microbes) facilitate the oxidative breakdown and restructuring of HA molecules, introducing new reactive sites and lowering molecular weight, which enhances HA's mobility and bioavailability in soil [112]. These biotransformations not only improve HA's efficacy as a plant growth enhancer and soil conditioner but also align with environmentally friendly and sustainable agricultural practices. Future studies should focus on evaluating the structure–function relationships of HAs from diverse origins and treatments under controlled and field conditions to better understand their physiological and biochemical impacts."

Ref. 110: Kluczek-Turpeinen, B.; Steffen, K.T.; Tuomela, M.; Hatakka, A.; Hofrichter, M. Modification of humic acids by the compost-dwelling deuteromycete *Paecilomyces inflatus*. *Appl. Microbiol. Biotechnol.* 2005, 66, 443–449.

Ref. 111: "Boguta, P.; Skic, K.; Sokołowska, Z.; Frąc, M.; Sas-Paszt, L. Chemical transformation of humic acid molecules under the influence of mineral, fungal and bacterial fertilization in the context of the agricultural use of degraded soils. *Molecules* 2021, 26, 4921.

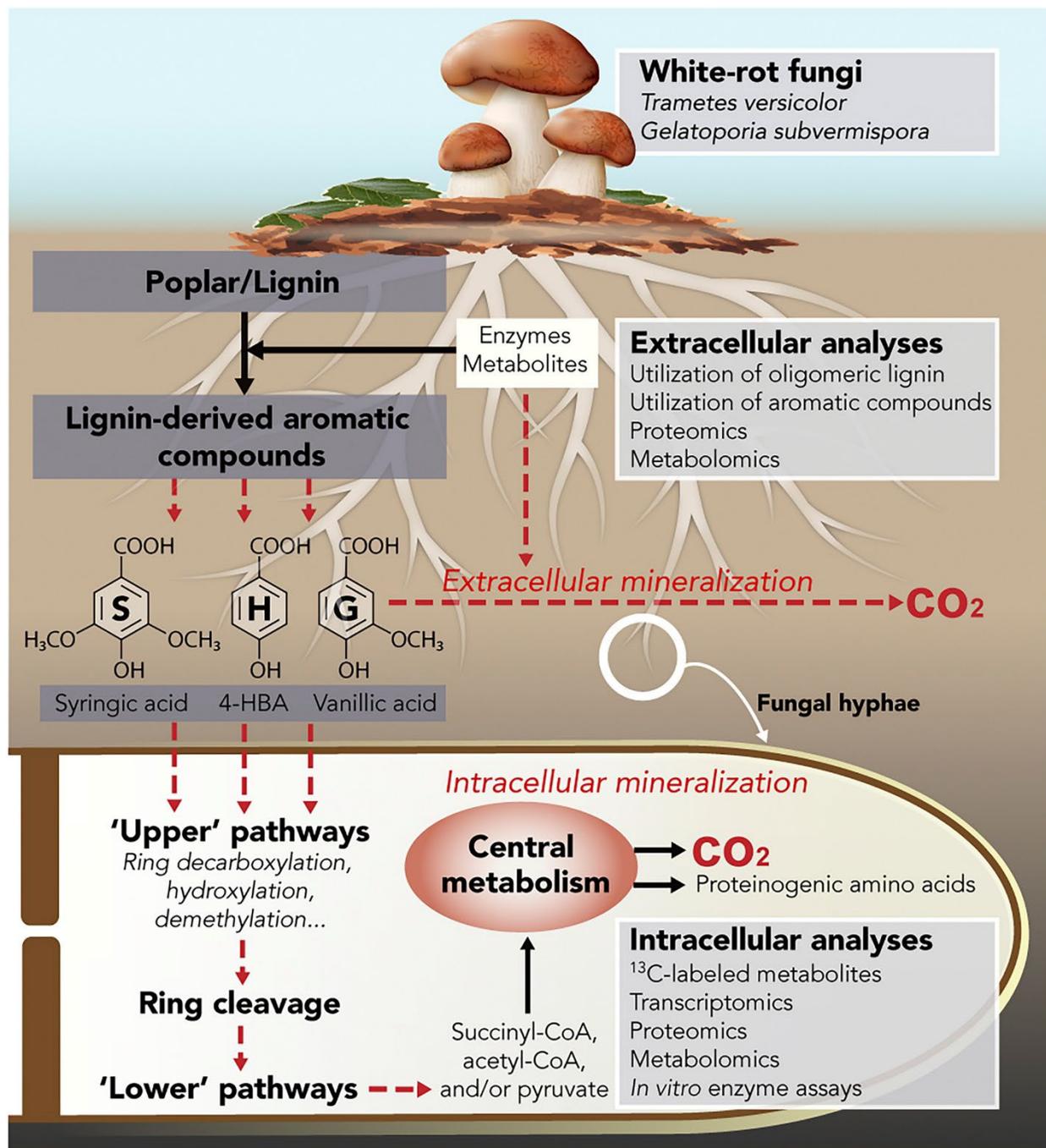
Ref. 112: Cha, J.Y.; Kim, T.W.; Choi, J.H.; Jang, K.S.; Khaleda, L.; Kim, W.Y.; Jeon, J.R. Fungal laccase-catalyzed oxidation of naturally occurring phenols for enhanced germination and salt tolerance of *Arabidopsis thaliana*: A green route for synthesizing humic-like fertilizers. *J. Agric. Food Chem.* 2017, 65, 1167–1177.

IFUS contends that it has discovered a natural eco-friendly and cost-effective mechanism that is seemingly optimizing natural Humic Substance creation. Hence, this Part D-3 White Paper (with the other SupremeAG™ White Papers found on the IFUS Website) is written with the intent of providing plausible evidence that SupremeAG™ can in fact (when used with "Best Gardening Practices") improve plant performance outcomes.

IFUS Point 5: Soil Microbial Biome

We offer another reminder: White Rot Fungi seem to be nourished by the ingredients in the SupremeAG™ with Nutri-Mastic™ formulation, resulting in the accelerated degradation and depolymerization of the lignin as demonstrated in Diagram 2 below. An invaluable component of lignin depolymerization is the production of H₂O and CO₂, both critical to soil and plant health and well-being...as well as Proteogenic Amino Acids (a source of protein for plants, animals, and humans).

Diagram 2:

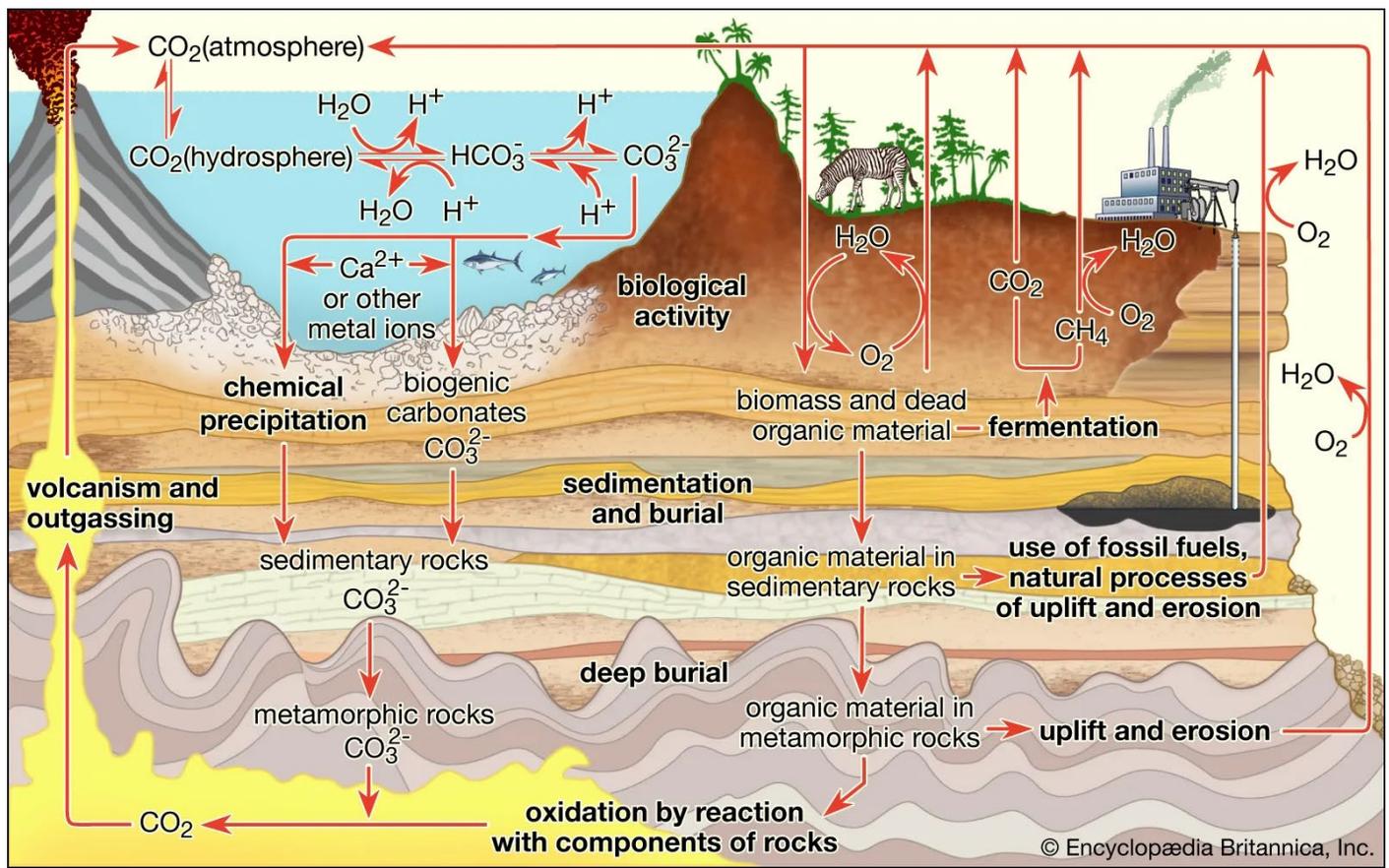


Source: "Intracellular pathways for lignin catabolism in white-rot fungi" written by

Carlos del Cerro, et.al in "The Proceedings of the National Academy of Sciences: Systems Biology/Biological Sciences," Feb. 23, 2021

What Other Plausible Evidence Supports IFUS Contentions of an Eco-friendly and Cost-effective solution: Mother Nature being "Intact" vs. "Toxic"

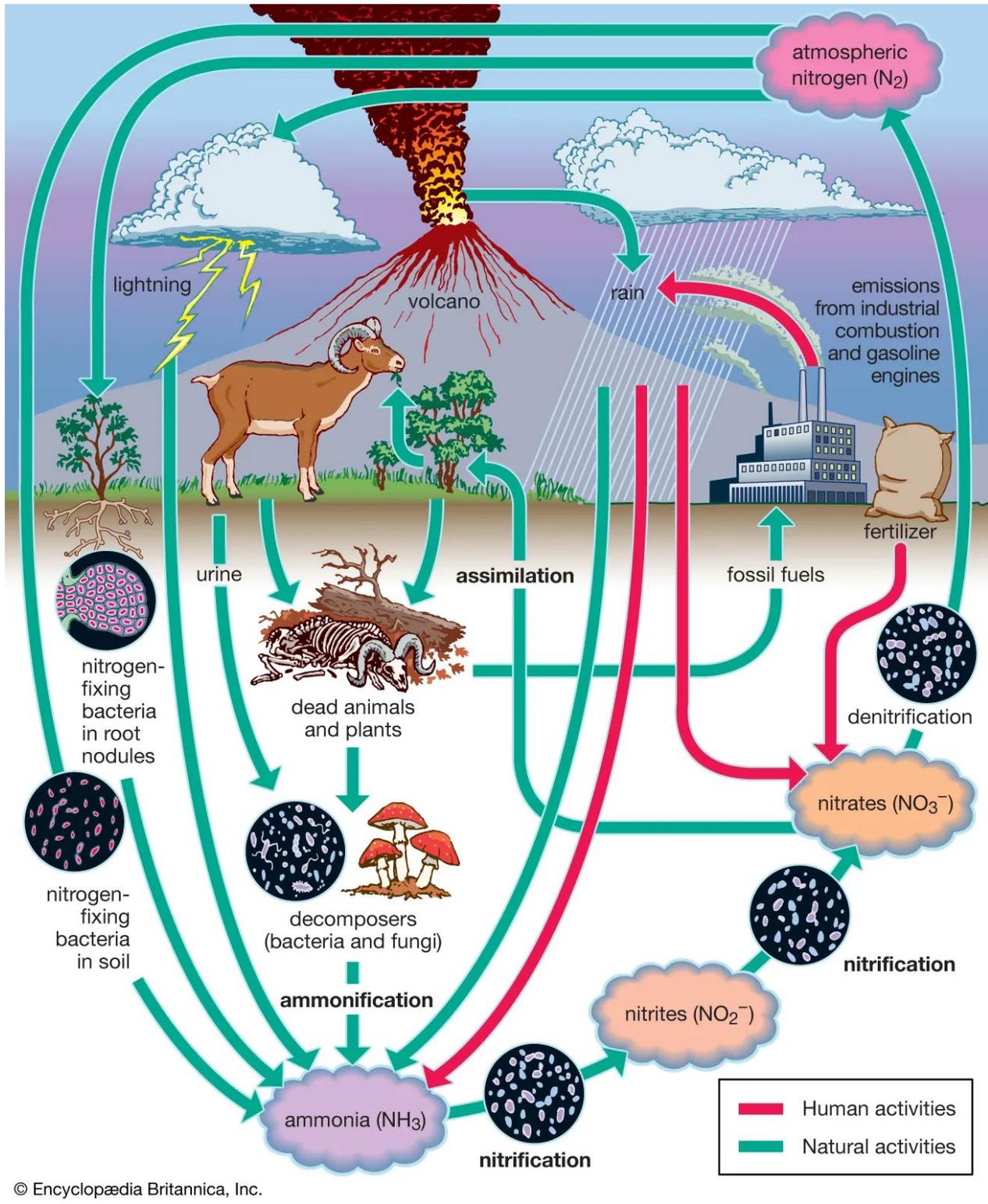
The diagram below attempts to illustrate within a given biosphere the various biomes at play to create a more "intact" glimpse into the "carbon-cycle."



Source: [Carbon cycle | Definition, Steps, Importance, Diagram, & Facts | Britannica](https://www.britannica.com/science/carbon-cycle):
[https://www.britannica.com/science/carbon-](https://www.britannica.com/science/carbon-cycle)

We find in yet another diagram (immediately below) an example of a biosphere with various biomes, whereby we find "The Nitrogen cycle": "Nitrogen fixation is the process by which atmospheric nitrogen is converted by either a natural or an industrial means to a form of nitrogen such as ammonia. In nature, most nitrogen is harvested from the atmosphere by microorganisms to form ammonia, nitrites, and nitrates that can be used by plants. In industry, ammonia is synthesized from atmospheric nitrogen and hydrogen by the Haber-Bosch method, a process that Fritz Haber developed about 1909 and which soon after was adapted for large-scale

production by Carl Bosch. Commercially produced ammonia is used to make a wide variety of nitrogen compounds, including fertilizer and explosives."



Source: <https://cdn.britannica.com/37/6537-050-CF14602B/ammonia-Nitrogen-fixation-nitrogen-form-means-nitrates-1909.jpg>

Hence, if IFUS is correct, then it is plausible that SupremeAG™ with Nutri-Mastic™ could potentially improve the "Nitrogen-Cycle" in an eco-friendly and cost-effective manner. In both animals and humans, end users of other IFUS Product Lines report the reduction in the smell of ammonia from human excretions, as well as the reduction of ammonia in urine from cattle. The cattle pastures are said to have a woody, spicy smell. This information is covered in White Papers on the IFUS Website under the SGP+™ tab.

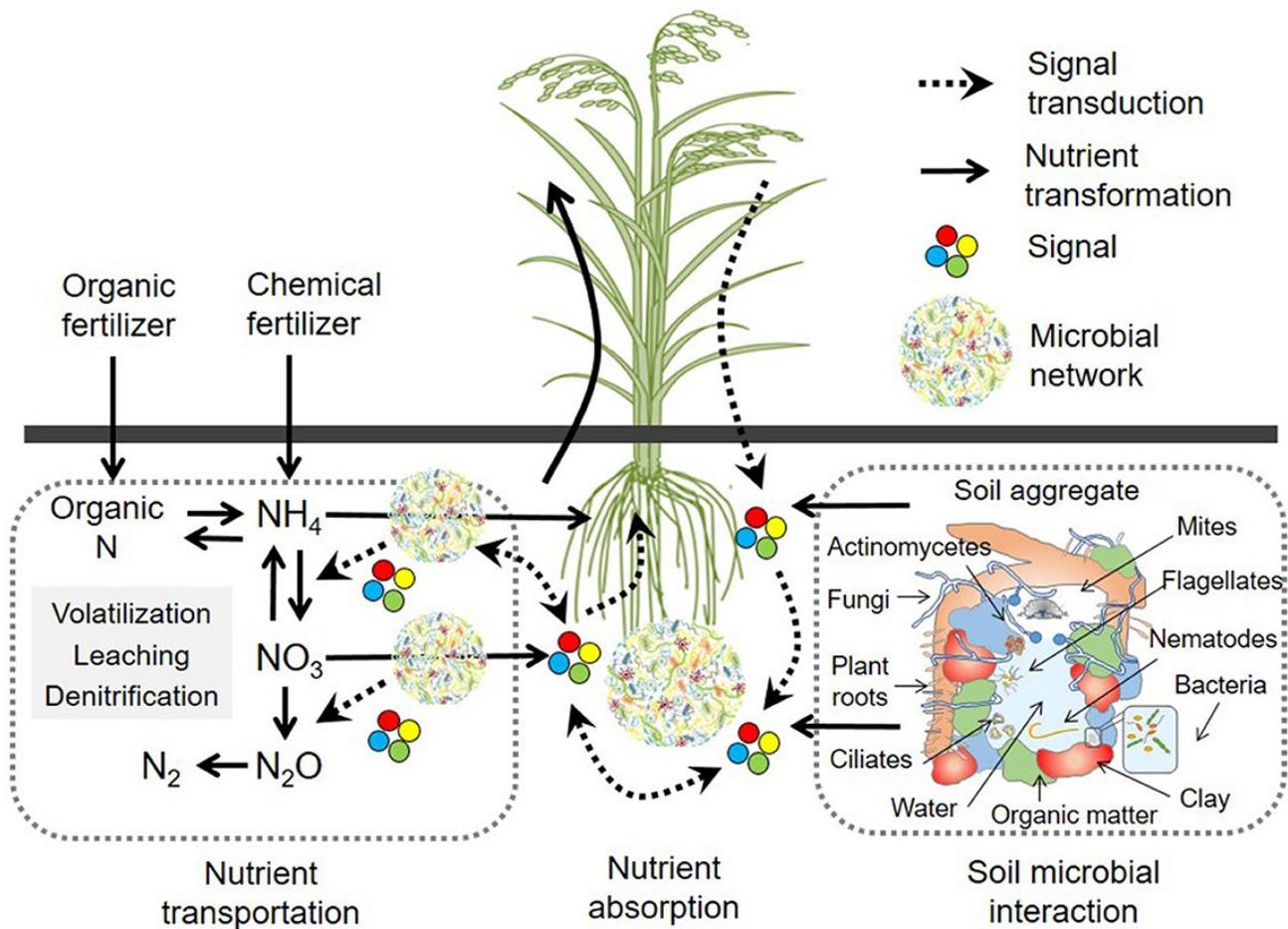
Furthermore, in Figure 1 below, we find yet another biosphere with biomes involved to create "Soil Health" as a "living system"...one influenced by both natural and man-made forces:

"Soil health is considered to be a central requirement of a sustainable, functioning agroecosystem (Al-Kaisi and Lowery, 2017). Since the 2010s, major programs to improve soil health have been launched in the USA (Honeycutt et al., 2020) and China (Sun et al., 2022). More recently, the European Commission set a mission in the 2021 Horizon Europe program to ensure the health of soil and provision of food. These high-level programs aim to address the current and future challenges of long-term food security and sustainable use of terrestrial ecosystems. **Soil health is defined as the capacity of soil to function as a living system, within ecosystem and land-use boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health (Doran and Zeiss, 2000).** It is a holistic concept, owing to the many chemical, physical and biological properties of soil, as well as to the many processes occurring in soils and the functions they provide. Bottom-up and top-down forces can both influence soil health through mediating belowground biological functioning (Figure 1)."

IFUS would have you focus on three dynamics presented in Figure 1:

- "Signal Transduction" & "Signal", which is said to be the electro-chemical function of critical and required macro- and micro-minerals in ionic form.
- "Nutrient Transformation", from the digestions (whether in the soil or in the gut) by a healthy microbial biome so that "absorption" can function effectively and efficiently.
- "Microbial Network", which is native and natural microbial biome, supported by the nutrients so that the microbes can transform ("digest") into recognizable chemicals ready for absorption and supported by macro- and micro-minerals in ionic form.

IFUS wonders whether humans have the capacity to synthetically create this biosphere, especially in consideration of the myriad of individual actions coupled by a complex array of interactions and relationships OR discovering a natural solution that mimics nature.



Source: Bo Sun and Andrew D. Barnes, *Front. Microbiol.*, 05 March 2023, Sec. Microbe and Virus Interactions with Plants, Volume 14 - 2023 | <https://doi.org/10.3389/fmicb.2023.1155234> (https://www.frontiersin.org/files/Articles/1155234/fmicb-14-1155234-HTML/image_m/fmicb-14-1155234-g001.jpg)

In contrast Toxic Soil as compared to Non-Toxic (Intact) soil.

Consistent with the science IFUS has reviewed to date, as well as contentions made by scientists like Dr. Robert Pettit, Dr. Sam Westreich, and others, the individual actions of any biosphere or biome, while examined in isolation for purposes of greater understanding, can ONLY be understood in the broader view of the total actions involved as well as the broader interactions and relationships among the totality of all.

To illustrate the point of the complex array of actions, interactions, and relationships of various biospheres (with an even greater array of biomes), we find a study conducted and published by Wenyin Wang, et.al., "Root exudates enhanced rhizobacteria complexity and microbial carbon metabolism of toxic plants,"

Source: (*iScience*, Volume 25, Issue 10, 2022, 105243, ISSN 2589-0042, <https://doi.org/10.1016/j.isci.2022.105243>. (<https://www.sciencedirect.com/science/article/pii/S2589004222015152>))

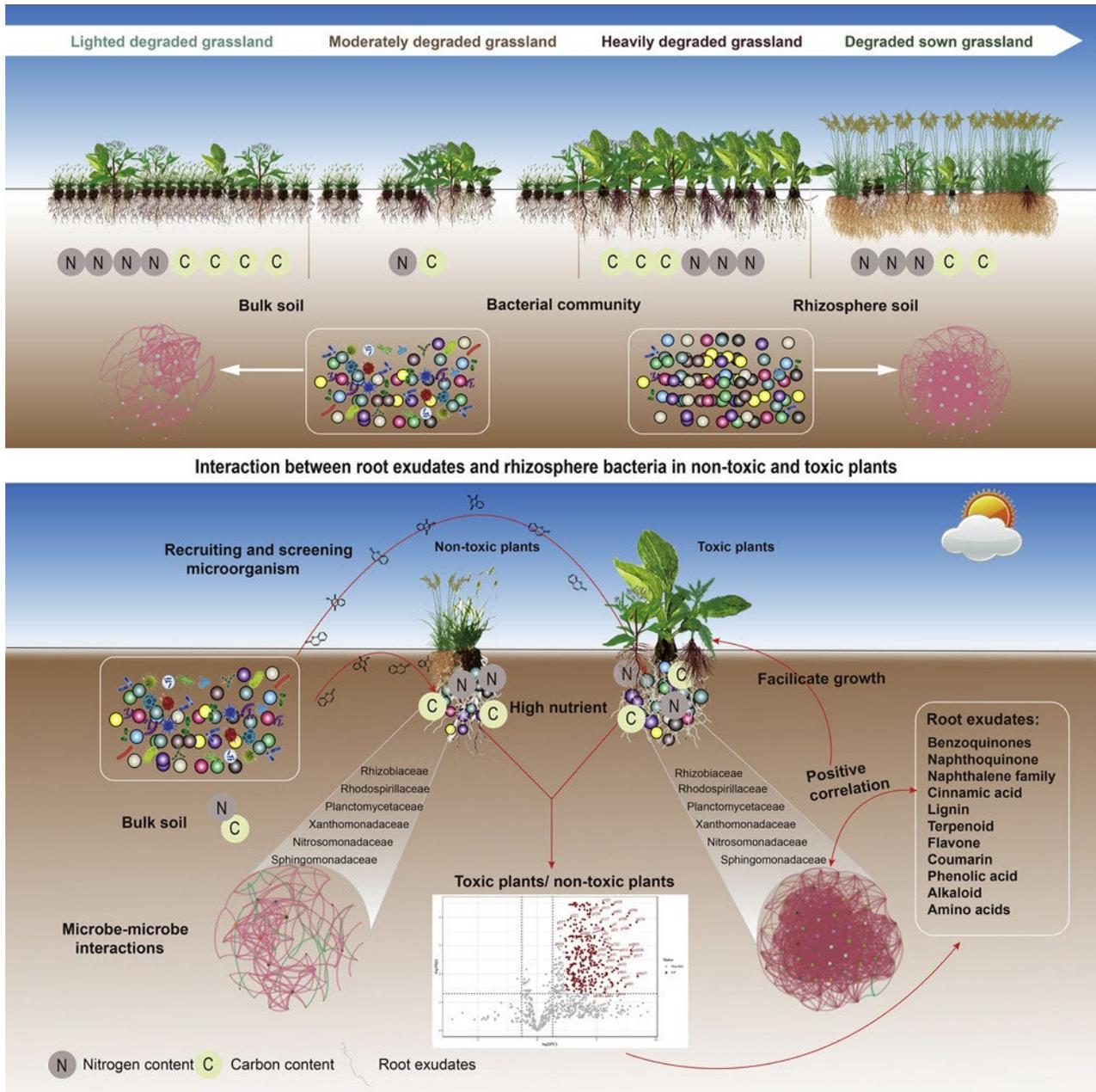
In this study, IFUS is struck by the contrast established of (1) various stages of degraded grasslands, (2) the impact on root exudates and the rhizosphere microorganisms, (3) the production of toxic plants, (4) the impact on microbial communities, and (5) the shift in the phytochemistry.

Again, the actions, interactions, and relationships of the various biomes within the context of a larger biosphere is illustrated and raises several key thoughts and questions (to be discussed later).

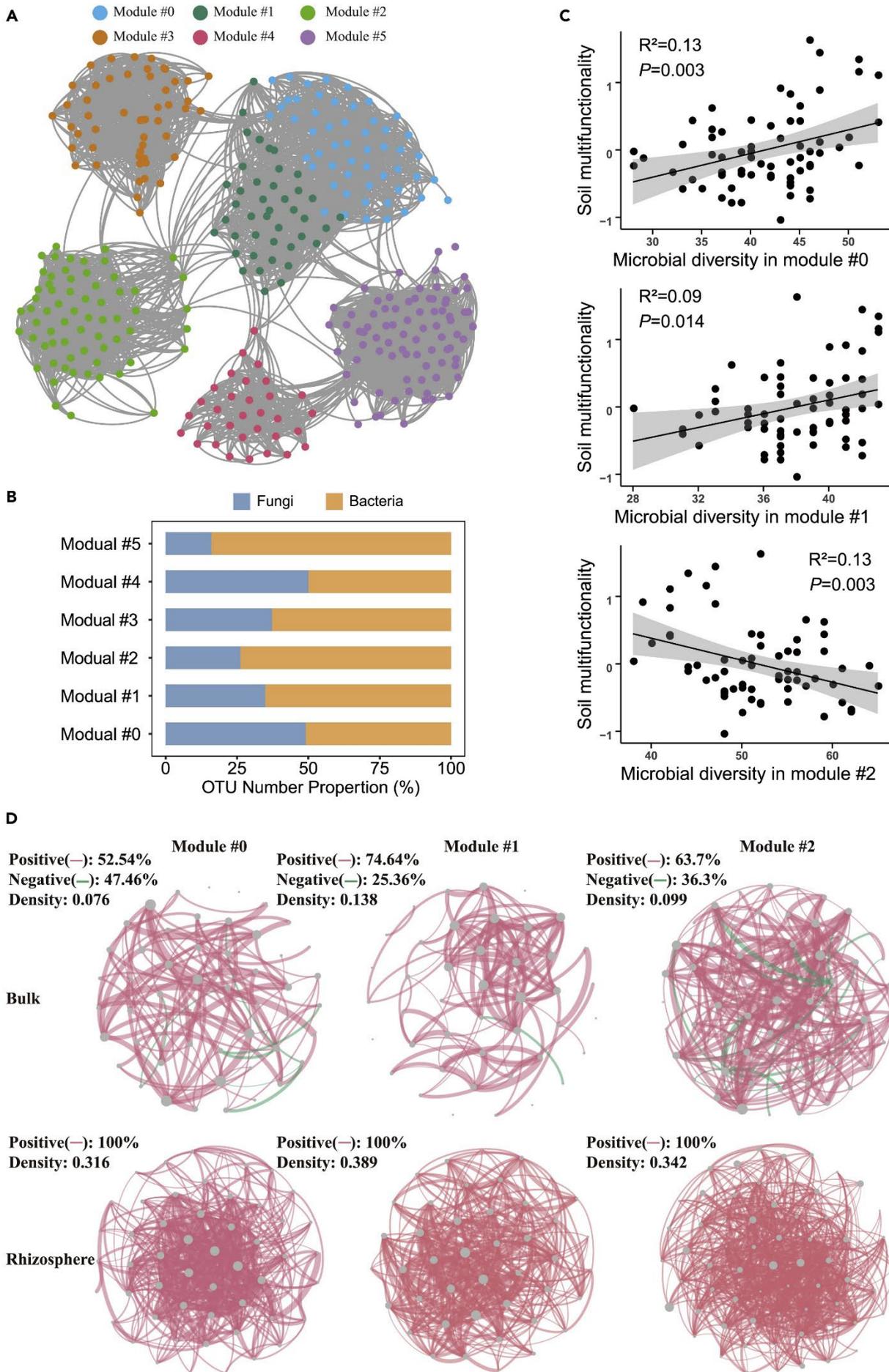
"Abstract: Summary

Root exudates and rhizosphere microorganisms play key roles in the colonization of toxic plants under climate change and land degradation.

However, how root exudates affect the rhizosphere microorganisms and soil nutrients of toxic plants in degraded grasslands remains unknown. We compared the interaction of soil microbial communities, root exudates, microbial carbon metabolism, and environmental factors in the rhizosphere of toxic and non-toxic plants. Deterministic processes had a greater effect on toxic than non-toxic plants, as root exudates affected rhizosphere microorganisms directly. The 328 up-regulated compounds in root exudates of toxic plants affected the diversity of rhizosphere microorganisms. Rhizosphere bacteria-enriched enzymes were involved in the phenylpropanoid biosynthesis pathway. Root exudates of toxic plants form complex networks of rhizosphere microorganisms, provide high rhizosphere nutrients, and increase microbial carbon metabolism. **The interaction between root exudates and rhizosphere microorganisms is the key mechanism that enables toxic plants to spread in degraded grassland habitats.**" (Please see "Graphical Abstract" below:)



Wenyin Wang, et.al. further offer the "Key-stone ecological cluster link to soil functions and root exudates: **Ecological networks were used to identify clusters of microbial taxa highly correlated with each other, which could share environmental preferences and functional potentials.** Six main ecological clusters (Module #0–5) were generated from the microbial network (Figures 3A and 3B). The gene network displayed that the relative abundances of microorganisms in key-stone ecological clusters were greater in most rhizospheres than in bulk soil (Table S4). The positive correlations among microbial taxa (density: 0.316–0.389) in rhizosphere were higher than in bulk soil (Figure 3D). Module #0–1 was correlated significantly and positively with [soil chemical properties](#), and negatively with Module #2 (Figure S4)."



"Figure 3. Ecological clusters based on microbial networks: (A) microbial network graph with nodes colored according to each of the six main ecological clusters (Module #0–5); (B) OTU number properties of the dominant phylotypes in the main ecological clusters; (C) regression relationships between soil biodiversity of key-stone ecological clusters (Module #0–2) and soil multi-functionality. Gray indicates confidence intervals; (D) dominant phylotypes from Module #0–2, the connection stands for a strong (Spearman's $r > 0.6$) and significant ($p < 0.05$) correlation. The size of each node is proportional to the degree, and the thickness of edge is proportional to the value of Spearman's correlation coefficient. A red edge indicates a positive correlation, while a green edge indicates a negative correlation."

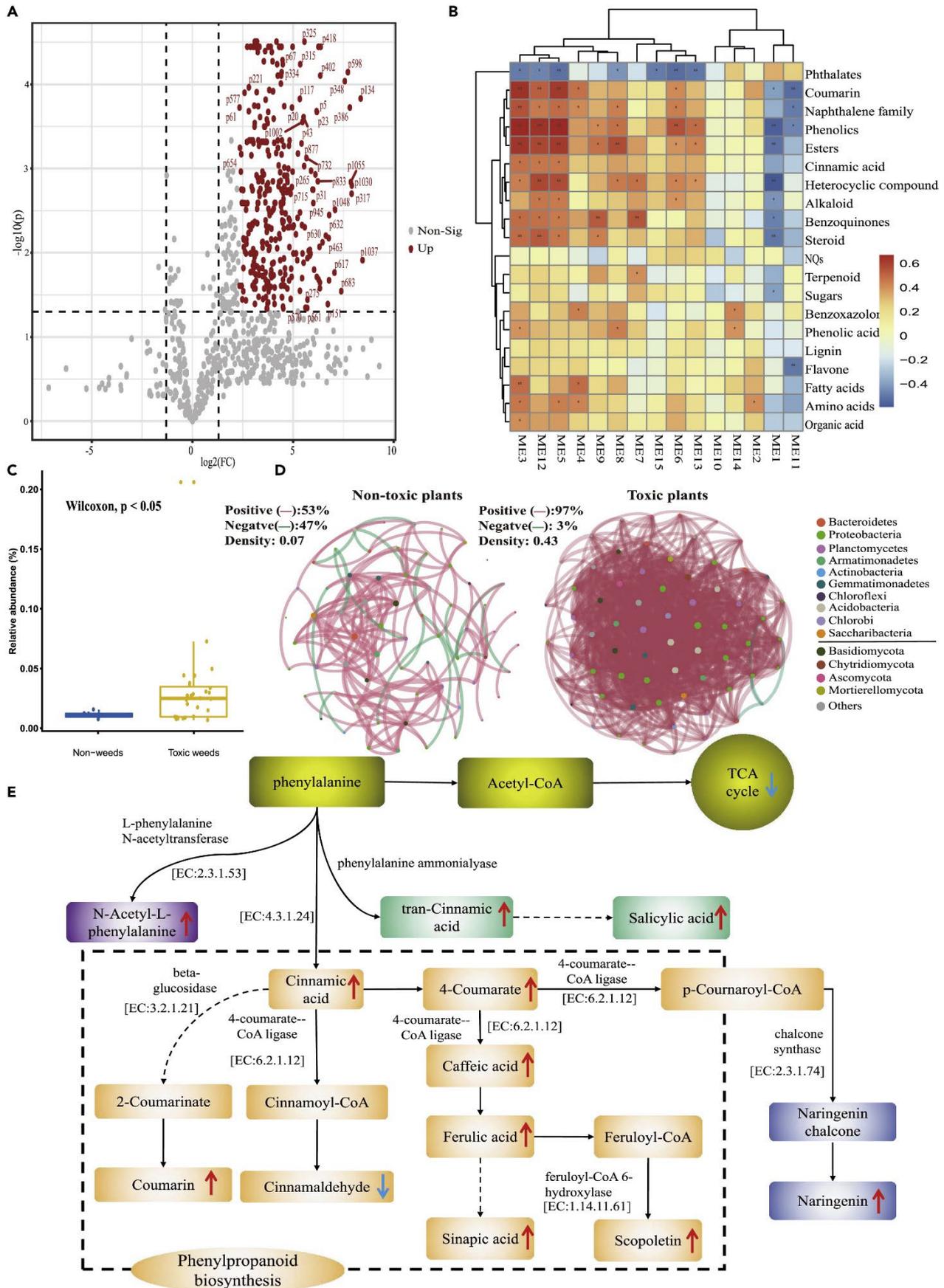
IFUS contends that SupremeAG™ with Nutri-Mastic™ is believed to provide an array of phytochemicals (to include critical phytohormones and proteogenic amino acids, minerals, vitamins, and water) placed in the proper place, in the proper form, and at the proper time such that plant and animal performance is enhanced. If IFUS is interpreting the aforementioned information correctly, then when grasslands are degraded, the phytochemicals (to include critical phytohormones and proteogenic amino acids, minerals, vitamins, and water) are NO longer able to be placed into the proper place, in the proper form, and at the proper time such that plant and animal performance is enhanced. Toxic Plants thrive and replace non-toxic plants in this altered reality.

Wenyin Wang, et.al. also provide: "Correlations between root exudates and microorganisms:

A total of 864 compounds were screened for analysis from 1092 compounds. The significantly up-regulated 328 compounds (Figure 4A) were selected through volcano analysis. The up-regulated compounds included benzoquinones, naphthoquinone (NQ), cinnamic acid (7), lignin (8), terpenoids (46), flavones (8), amino acids (11), coumarin (11), naphthalene family (17), phenolic acids (21), and alkaloids (20) (Figure 4B). Root exudates were species specific and the similarity of root exudates between different toxic plants was higher than with non-toxic plants (Figure S5)."

IFUS has explored cinnamic acid, lignin, terpenoids, flavones, phenolic acids, and alkaloids to date. Admittedly, when considering each of these individual phytochemicals or phytochemical sources, in the greater scheme of science, IFUS' exploration is cursory. However, even this cursory exploration has led to discoveries that when connected and/or overlaid, suggest plausible explanations as to the performance improvements of plants, trees, and shrubs mulched and/or soil amended with SupremeAG™ with Nutri-Mastic™.

Hence, we consider yet another Graphical Representation in Figures 4A, B, C, D & E below:



Of further note from the study conducted and published by Wenyin Wang, et.al, it the "Relationships of microbial diversity, soil properties, carbon metabolism and root exudates:

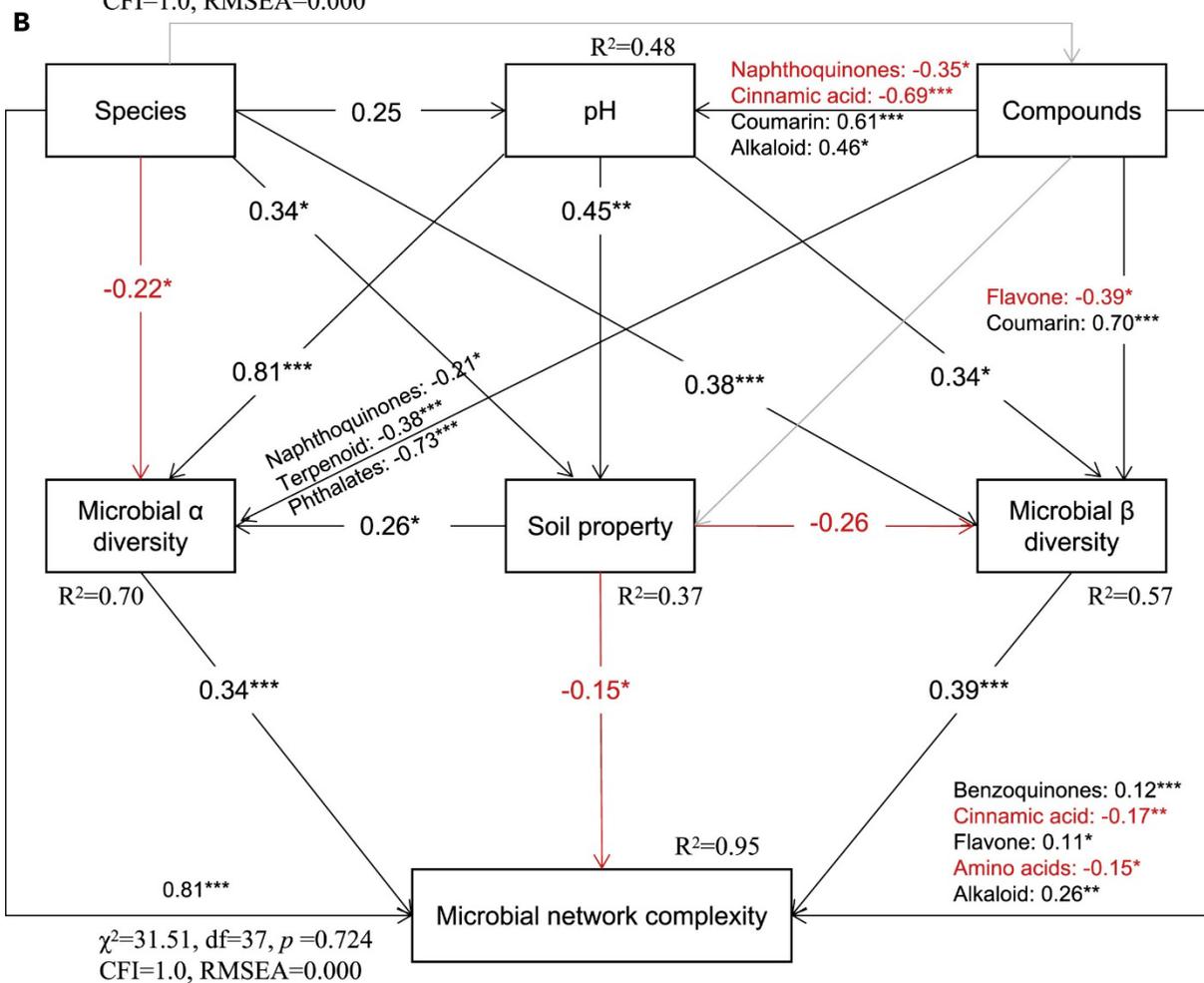
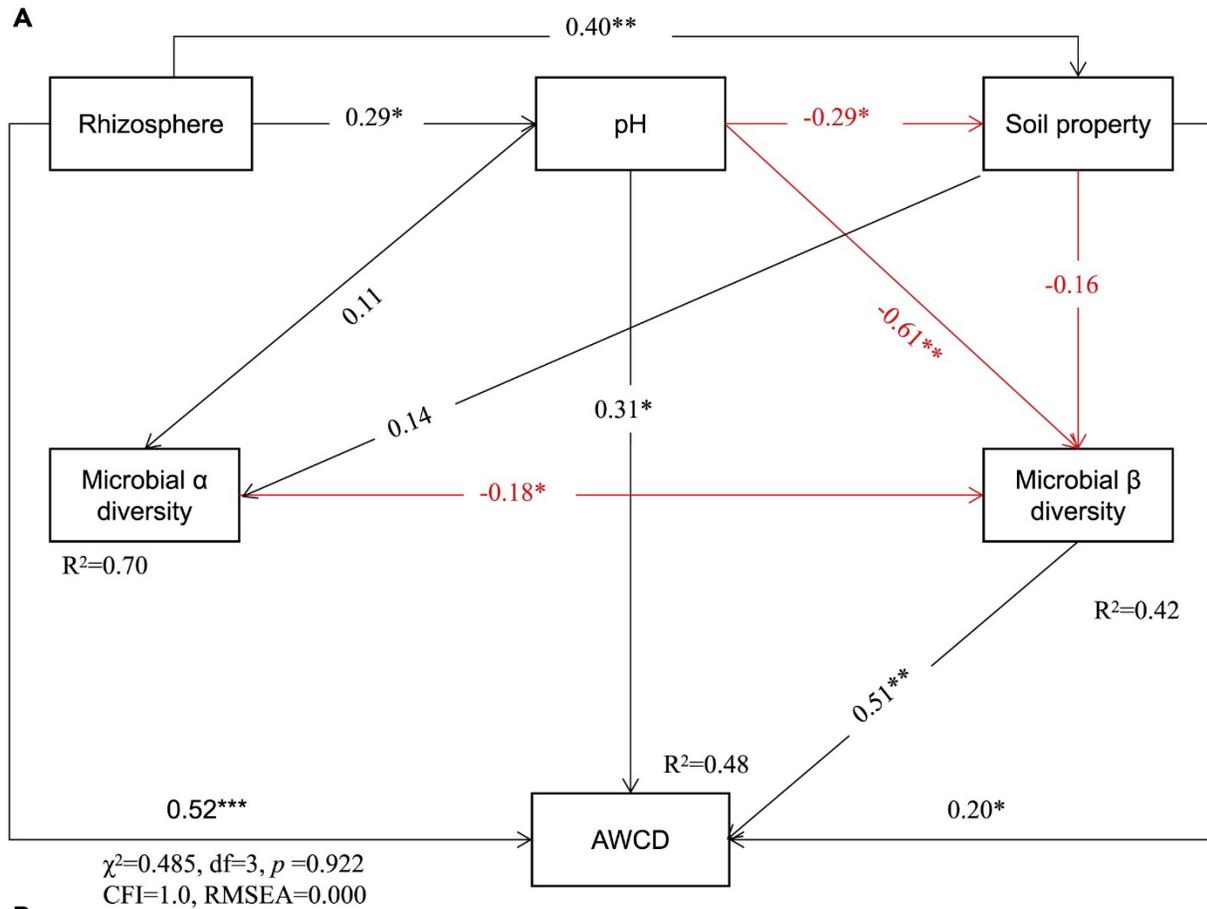
Structural equation modeling (SEM) was used to determine the drivers of changes in soil microbiota (Figure 5). Rhizosphere and plant species were the strongest direct drivers of soil properties. Soil pH and microbial α influenced microbial β diversity directly, whereas, rhizosphere, pH, microbial community, and soil properties influenced microbial C metabolism (Figure 5A). The average well-color developments (AWCDs) of rhizosphere in toxic plants were greater than in bulk soil in the four levels of degraded grasslands (Figure S9A). The first principal component in the four degraded grasslands of S, H, M, and L were 54.2%, 50.5%, 48.5%, and 47.0%, respectively, and indicated that the microorganisms of different plant rhizospheres and bulk soil used C sources differently (Figure S9B)."

The IFUS exploration into this science continues as insight is offered into pH regulation of soil in connection to the microbial biospheres (and subsequent microbial biomes) as well as soil properties and phytochemicals.

IFUS, through various studies, has attempted to offer plausible evidence that SupremeAG™ is unique in its offering of said phytochemicals with the naturally sourced micro- and macro-minerals in proper balance and concentration, such that the microbial biome is supported within Humic Substance to support soil structure and properties vital to healthy non-toxic plants, trees, and shrubs. Weed suppression has been noted when SupremeAG™ is applied as a mulch and/or soil amendment.

IFUS finds additional evidence of its contentions in Figure 5 below (provided by Wenyin Wang, et.al): "Effects of soil properties and microbial structure on microbial carbon metabolism (A) and the complexity of microbial networks (B)

"The rectangles represent variables of soil (rhizosphere and bulk soil); soil pH; species (toxic and non-toxic plants); soil property, the first axis of PCA analysis of soil total organic carbon (TOC), total nitrogen (TN), total phosphorous (TP), available phosphorous (AP), nitrate nitrogen (NO₃-N), ammonium nitrogen (NH₄-N), dissolved organic nitrogen (DON), available potassium (AK), available sodium (ANa) and water content (WC); microbial α diversity; microbial β diversity; compounds, the relative abundance of root exudates; AWCD, the average well-color development. Microbial network complexity, the edge of co-occurrence networks. The proportion of explained variance (R²) appears alongside variables in the model. χ^2 , Chi-square; df, degrees of freedom; p, probability level; RMSEA, root-mean squared error of approximation are the goodness-of-fit statistics for each model. Significance levels of each predictor were *p < 0.05, **p < 0.01."



Wenyin Wang, et.al add in their "Conclusions:"

"Overall, the convergence of root functions in toxic plants could improve their adaptability in different degraded grasslands. Toxic plants secrete more bio-active compounds beneficial to plant growth than non-toxic plants. These compounds include naphthoquinones, terpenoids, phthalates, amino acids, coumarin, and flavones, which alter microbial diversity. The assembly of rhizosphere microorganisms was mainly a stochastic process. The deterministic process (niche theory) also contributed and had a greater effect on toxic than non-toxic plants, as root exudates directly affected the assembly of rhizosphere microorganisms. Compared with bulk soil, the rhizosphere had higher nutrients and greater microbial C metabolism activity. In addition, the network of the microbial community in the rhizosphere of toxic plants was more complex and had higher positive correlations among microorganisms than bulk soil and rhizosphere of non-toxic plants, indicating greater interaction and niche sharing potential among microorganisms in the rhizosphere of toxic plants. Bacteria in the rhizosphere of toxic plants were enriched in the phenylpropanoid biosynthesis pathway. **It is concluded that the strong interaction between root exudates and microorganisms is the key mechanism for the divergent habitat adaptation of toxic plants in different degraded grasslands, supporting above-ground plant growth and reproduction."**

IFUS also contends that a worthy consideration is offered by Wenyin Wang, et.al, that is reflective of the complex nature of the science we are all considering:

"Limitations of the study: Climate warming may affect the metabolism of plants, increase the defense substances and promote the invasion of weeds (Rice et al., 2021). In the present study, increased content of defensive substances was present in the roots of toxic plants in a degraded alpine grassland on the Qinghai-Tibetan Plateau. These substances have a direct effect on the assembly process of rhizosphere microorganisms, which may have a positive effect on the reproduction of toxic plants. Studies that support this argument directly are few. In addition, since toxic weeds are usually perennial plants, it is not clear whether responses are similar at different stages of growth. Further studies on different growth stages of toxic weeds are needed, in particular in the later stages. Whether rhizosphere microorganisms and root exudates are similar in different growth stages also requires further research."

IFUS contends that we can fight "Mother Nature" and/or compete with her OR we can work cooperatively with "Her" to create "Intact" outcomes that (1) do no harm and (2) create enormous benefit for all parts concerned. If (1) and (2) are our intentions, then the question remains "How?"

The "How" begs yet another question; that being, can we find a way in which "Human Activities" can benefit humans, animals, and plants, whereby all parts of the equation become "Eco-centric", while allowing for the expansion of economic prosperity for all of humanity. Imagine using the "energy" contained within "Bio-centric" ideals and transforming (i.e., utilizing) that very "energy" (even the present day "destructive" parts) so as to refocus that "energy " into Performance-Based Global Eco-Centric Outcomes for Individual and Collective prosperity.

What if IFUS is correct that SupremeAG™ with Nutri-Mastic™ can increase phytochemical production in non-toxic plants, such that these plants can supersede the growth and performance of toxic-plants...and do so in an eco-friendly and cost-effective method? Again, IFUS has reports of natural weed suppression when plants, trees, and/or shrubs mulched and/or soil amended with SupremeAG™ with Nutri-Mastic™.

Hence, per President John F. Kennedy: "A rising tide lifts all the boats and as Arkansas becomes more prosperous so does the United States". And, as the aphorism suggests, as the United States becomes more prosperous, so does every nation on the planet (as well as each and every plant, animal, and human). And, this can be achieved without destroying thriving present-day economic systems, but through the enhancement of the myriad of micro- and macro-economic entities functioning on the globe.

We thus find ourselves again asking, "How?"

When considering Diagrams D, E, F, G, and H (each of which progressively illustrate the impact and involvement of minerals in root development, plant health, plant yield, and ultimately nutritive value), the IFUS Scientific Team finds reinforcing evidence for its contentions. (See the Diagrams offered below)

Diagram D: Note in Red:

1. Cation Exchange
2. Binding of Cations
3. Release of Minerals

ROOT EFFECT ON ACIDIC AND ALKALINE SOIL

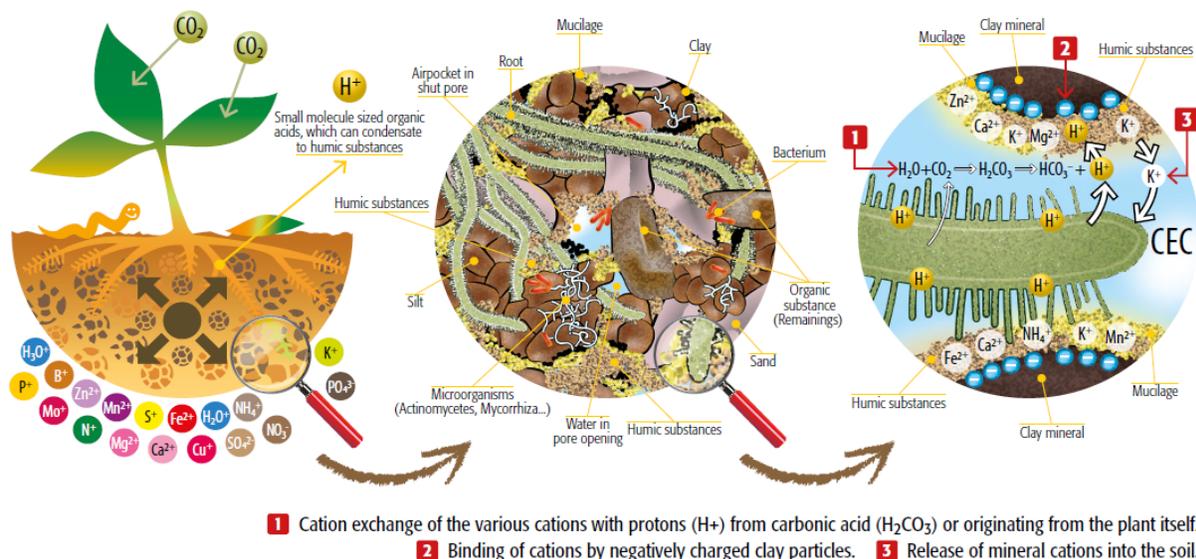


Figure 2.12

Own representation. (Copyright © Humintech 2018)

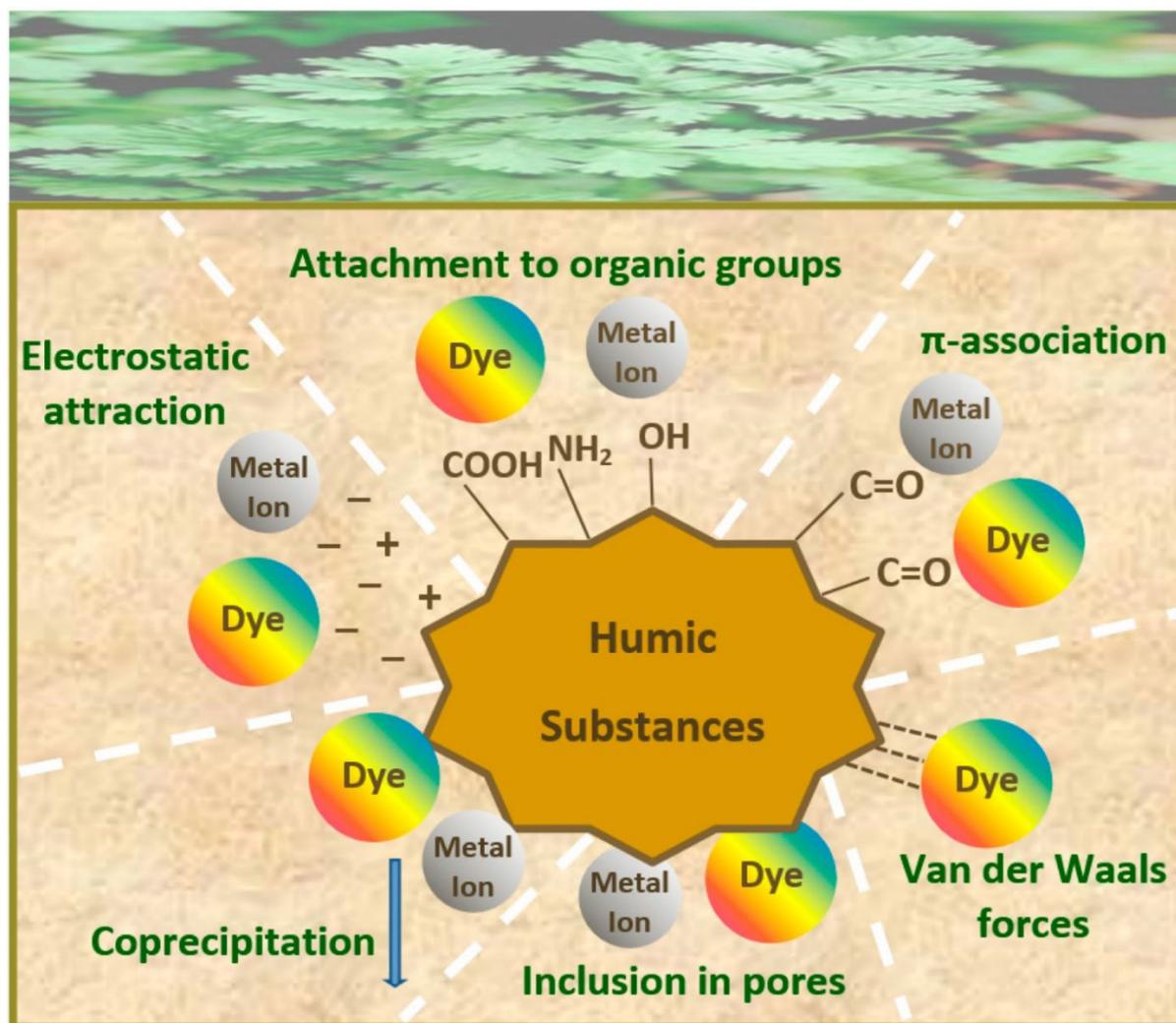
Source: [Root effect on acidic and alkaline soil - Humintech.png \(1130×798\)](https://www.humintech.com/fileadmin/content_images/agriculture/information/what_are_humic_acids/Root_effect_on_acidic_and_alkaline_soil_-_Humintech.png)
https://www.humintech.com/fileadmin/content_images/agriculture/information/what_are_humic_acids/Root_effect_on_acidic_and_alkaline_soil_-_Humintech.png

From a scientific perspective, the 72-minerals contained in Nutri-Mastic™, coupled with minerals found in the other natural ingredients in SupremeAG™, as well as the reported performance on plants being soil-amended and/or mulched with the product, leads IFUS to contend that one could logically offer the aforementioned as plausible science in support of the efficacy of SupremeAG™.

We continue with Diagram E.

Diagram E offers further scientific explanation of the effect and synergistic interaction between minerals ("Metal Ion"), "organic groups" (various phytochemicals), "Humic Substance", and natural physical and chemical forces that allow for healthy plant performance:

Diagram E:



[agronomy-13-02926-g002.png \(1799×1558\)](https://www.mdpi.com/agronomy/agronomy-13-02926/article_deploy/html/images/agronomy-13-02926-g002.png)

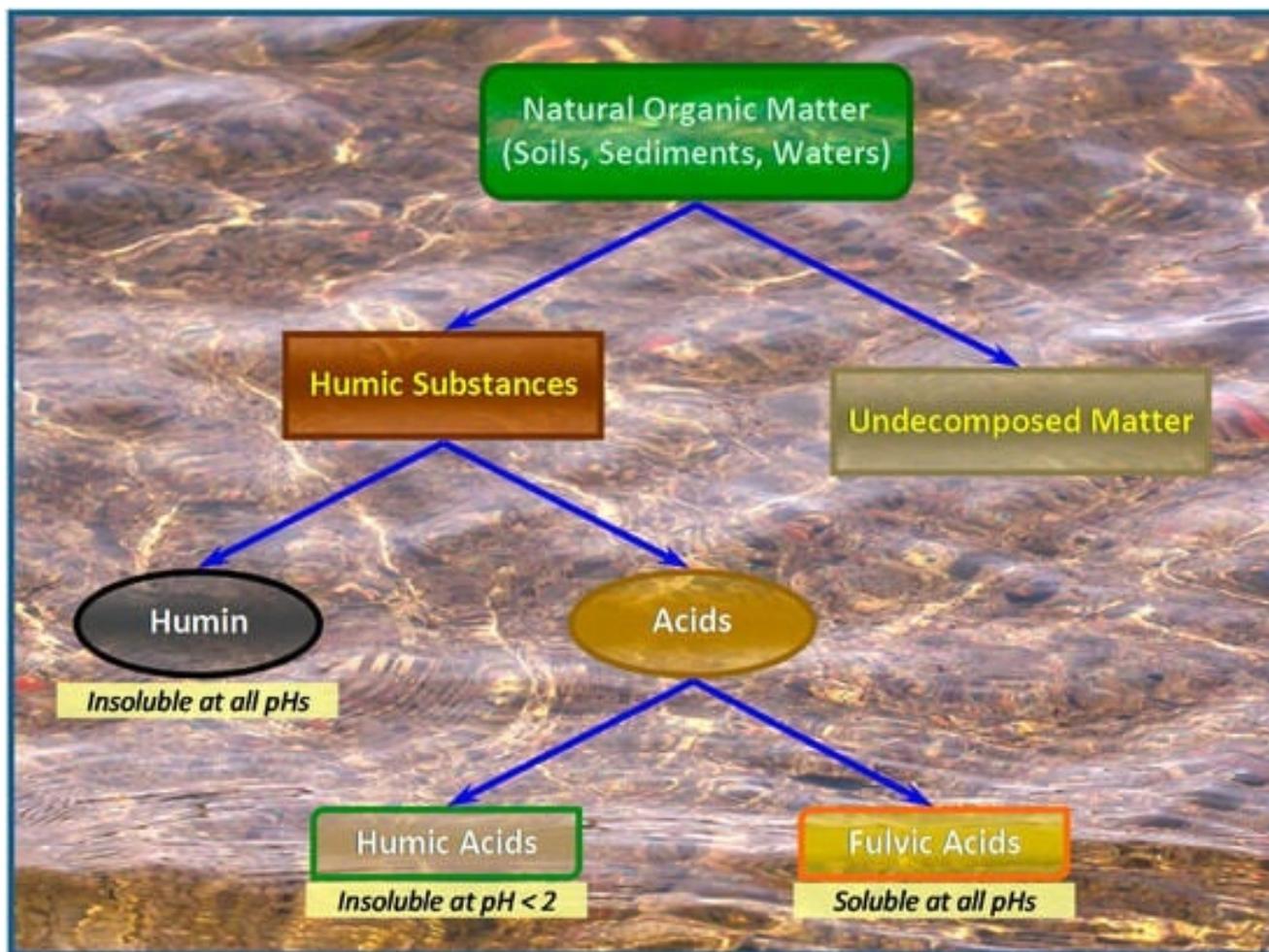
https://www.mdpi.com/agronomy/agronomy-13-02926/article_deploy/html/images/agronomy-13-02926-g002.png

Once more, IFUS finds evidence of the impact of ionic minerals on the actions, interactions, and relationships with organic functional groups and intricate physical forces critical to plant nutrition and health. The presence of Humic Substances, specifically naturally produced Humic Substances, are suggested by this science to be of paramount importance.

This leads IFUS to consider Diagram F.

Based on this diagram of natural Humic Substance, it is plausible that SupremeAG™ could increase the concentration of beneficial "Natural Organic Matter" to include Humic Acid, Fulvic Acid, and Humin, so as to overcome that which (per Dr. Pettit of Texas A&M) is said to be negatively affected by the application of synthetic acid fertilizers. This is notwithstanding other negative

practices or impacts like over-farming, topsoil erosion, climate change, and more.



Source: [656eb90300ea2agronomy-13-02926-g001-550.jpg](https://www.researchgate.net/publication/312222222) (550×410)

Of note is the notion that Nutri-Mastic™ is believed to assist in the regulation of gut pH in humans and animals. The IFUS Scientific Team is wondering if a similar beneficial regulation in soil is occurring, which impacts Humic and Fulvic Acids as well as Humin.

IONIC MINERALS AND INTERPLAY WITH SOIL BIOME

Hence, we return to the question as to where this Humic Substance evolves, especially from SupremeAG™. The IFUS contention is the eco-friendly and cost-effective degradation and depolymerization of recalcitrant lignin found in Sugarcane Bagasse by White Rot Fungi and the overall natural microbial biosphere seemingly nourished by Nutri-Mastic™ and Carob (further enabled by the IFUS Proprietary

Processing Methods).

Dr. Sutradhar and his team provide further insight into the degradation and depolymerization of lignin:

Pathway 2:

Y. Ouni et al. / International Journal of Plant Production (2014) 8(3): 353-374

357

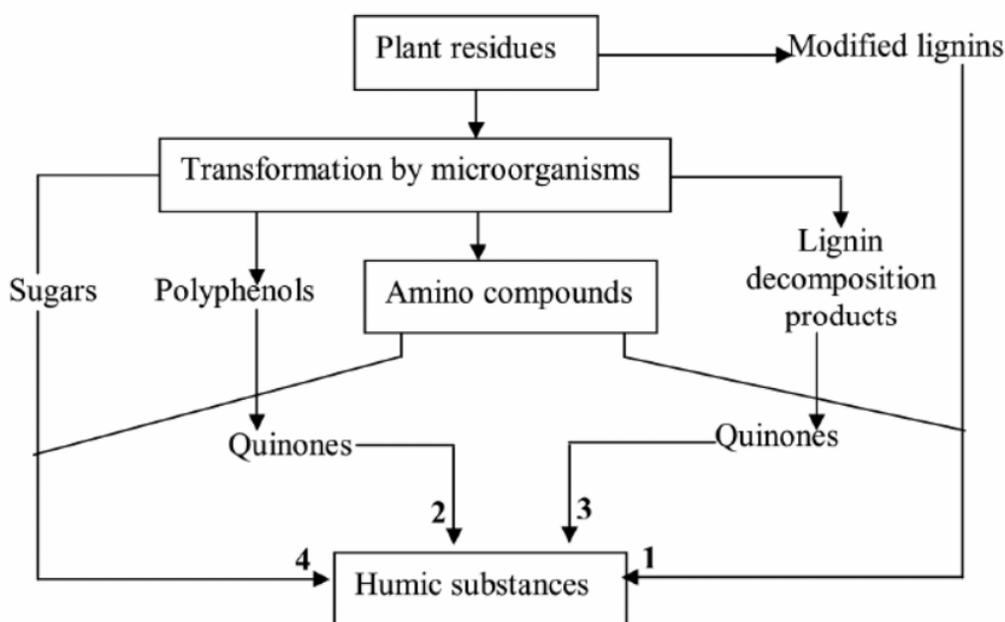


Figure 1. Mechanism of humic substances formation (Stevenson 1982). (1) theory of Lignin, (2, 3) theory of polyphenols and (4) theory of amino-saccharidic condensation.

Theory of Lignin (way formation 1)

It is the classical theory defined by Waksman (1932). It hypothesized that HS formation starts from the modified lignin (Figure 1). The latter component is an easily biodegradable bio-polymer made up of an assembly of three types of units phenylpropanoids connected between them by various types of connections C-C and ethyl oxide. The process consists of a combination of modified lignin molecules with nitrogenized components of proteinic type (amino compounds) synthesized by the micro-organisms (Stenvenson, 1994), according to the following reaction:



Accordingly, the lignin is incompletely used by the micro-organisms, because of the solidity of its structure (stable connections C-C) and, as a consequence, its residue becomes the constituent part of the soil humus (Saiz-Jimenez et al., 1989).

Source: [Mechanism-of-humic-substances-formation-Stevenson-1982-1-theory-of-Lignin-2-3.png \(850×533\)](https://www.researchgate.net/profile/Youssef-Ouni/publication/262414337/figure/fig2/AS:667835118399503@1536235708676/Mechanism-of-humic-substances-formation-Stevenson-1982-1-theory-of-Lignin-2-3.png): <https://www.researchgate.net/profile/Youssef-Ouni/publication/262414337/figure/fig2/AS:667835118399503@1536235708676/Mechanism-of-humic-substances-formation-Stevenson-1982-1-theory-of-Lignin-2-3.png>

An "INTACT" plant:

IFUS contends that select products can certainly improve the performance outcomes of plants, trees, and shrubs. IFUS also contends that based on the science being reported, that many of these products are NOT creating sustainable outcomes for the same plant, trees, and shrubs. Does this mean that all of the products are bad? No!

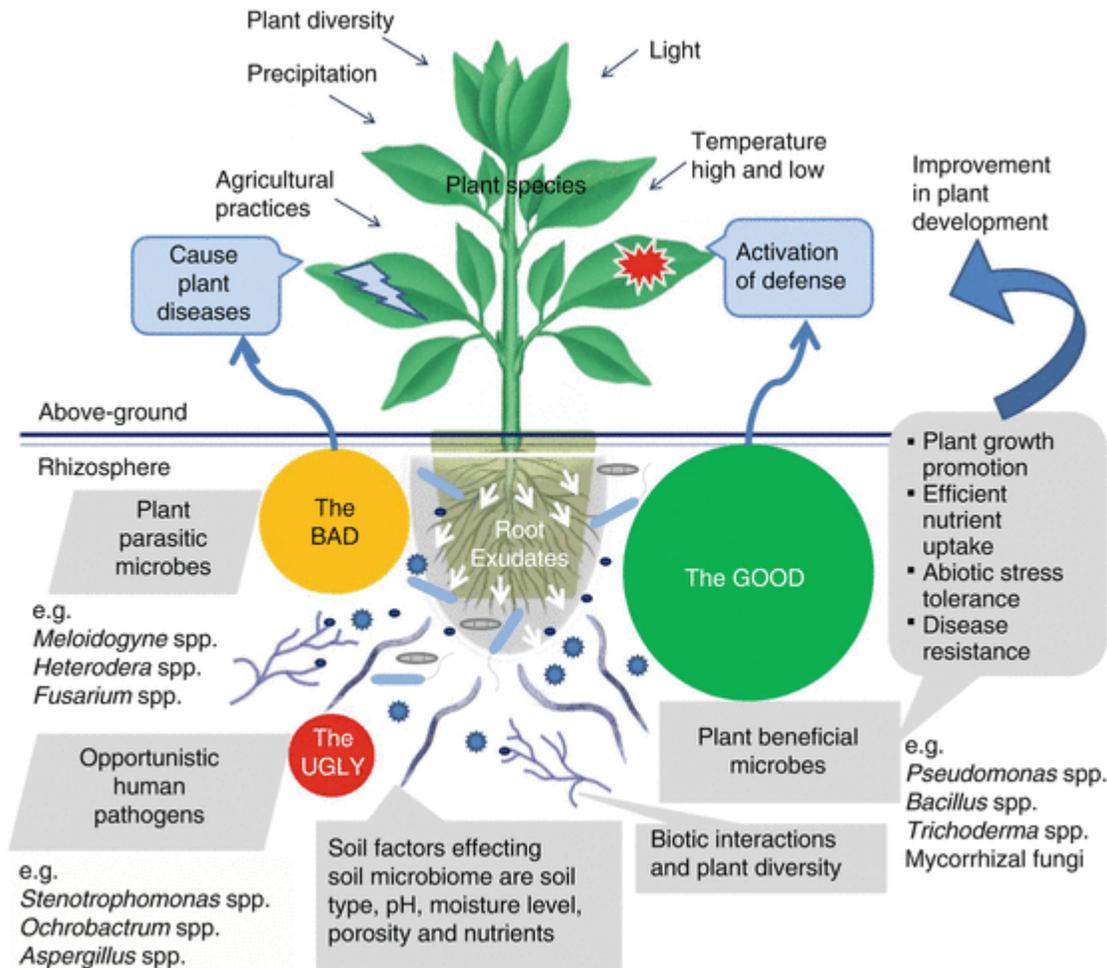
IFUS is suggesting that as science has progressed, as well as the needs of emerging human populations (as well as an ever-transforming planet both by natural and human effects), then there seems to be a call for products / technologies that may be more readily able to reduce the negative consequences and improve the beneficial outcomes in a more eco-friendly, cost-effective, and sustainable manner.

Such is the case of work written by Ali, M.A., Naveed, M., Mustafa, A., Abbas, A. (2017). "The Good, the Bad, and the Ugly of Rhizosphere Microbiome."

Source: Kumar, V., Kumar, M., Sharma, S., Prasad, R. (eds) Probiotics and Plant Health. Springer, Singapore. https://doi.org/10.1007/978-981-10-3473-2_11

"Abstract: Rhizosphere is the portion of soil that is exposed to the root activity. It is hot spot for microbial activities which support the plant growth and development in different ways. Microbial communities in the rhizosphere referred as rhizosphere microbiome are one of the most diverse regions of the ecosystem existing on Earth. Rhizosphere microbiome is biologically the most diverse part of the ecosystem which contains a large number of microbial communities which interact with the plants differently like the good, the bad, and the ugly microbes of rhizosphere. The good ones are beneficial microbes of the rhizosphere which are involved in plant growth promotion through nutrient uptake in plants, antagonism to plant pathogens, and plant tolerance against abiotic stresses. However, the bad ones are plant parasitic fungi and nematodes which cause diseases of economic importance in important crop plants and result in serious issues of reduction in productivity and food security. Similarly, some rhizosphere microbes avail the opportunity to invade the human body through different courses and cause infectious diseases. These opportunistic microbes are "the ugly" ones as they are the most deleterious in nature. In this chapter, we have discussed in detail the good, the bad, and the ugly members of rhizosphere microbiome. Moreover, we have given a comprehensive account of bolts

and nuts of rhizosphere and engineering of rhizosphere for agriculturally sustainability."



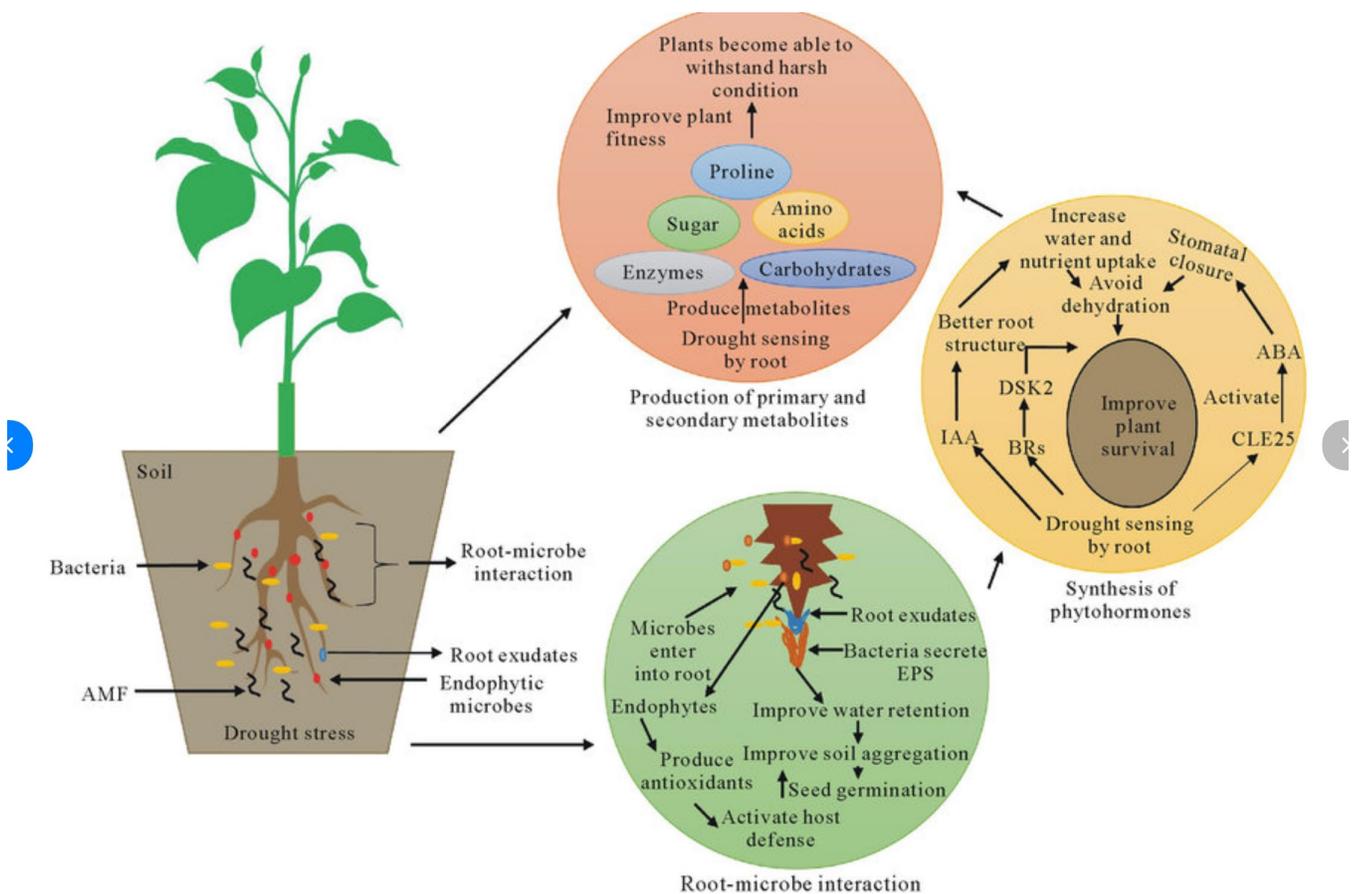
Hence, the diagram above illustrates the critical interactions in the rhizosphere, where plant roots, microbes, and root exudates can work together to support soil health and plant growth OR create the exact opposite. Where IFUS deeply values this excellent scientific effort, we contend that "engineering of the rhizosphere" might be best placed into the hands of "Mother Nature" vs. "humans."

An additional study performed by Muhammad Aslam, et. al (2022), "Rhizosphere microbiomes can regulate plant drought tolerance," offers insight into the effect of a healthy soil microbial biome and the health of the rhizosphere (hence, the plant).

Please note the actions, interactions, and relationship of the various biomes in relationship to the overall biosphere.

"Beneficial root-associated rhizospheric microbes play a key role in maintaining host plant growth and can potentially allow drought-resilient crop production. The

complex interaction of root-associated microbes mainly depends on soil type, plant genotype, and soil moisture. However, drought is the most devastating environmental stress that strongly reduces soil biota and can restrict plant growth and yield. In this review, we discussed our mechanistic understanding of drought and microbial response traits. Additionally, we highlighted the role of beneficial microbes and plant-derived metabolites in alleviating drought stress and improving crop growth. We proposed that future research might focus on evaluating the dynamics of root-beneficial microbes under field drought conditions. The integrative use of ecology, microbial, and molecular approaches may serve as a promising strategy to produce more drought-resilient and sustainable crops."



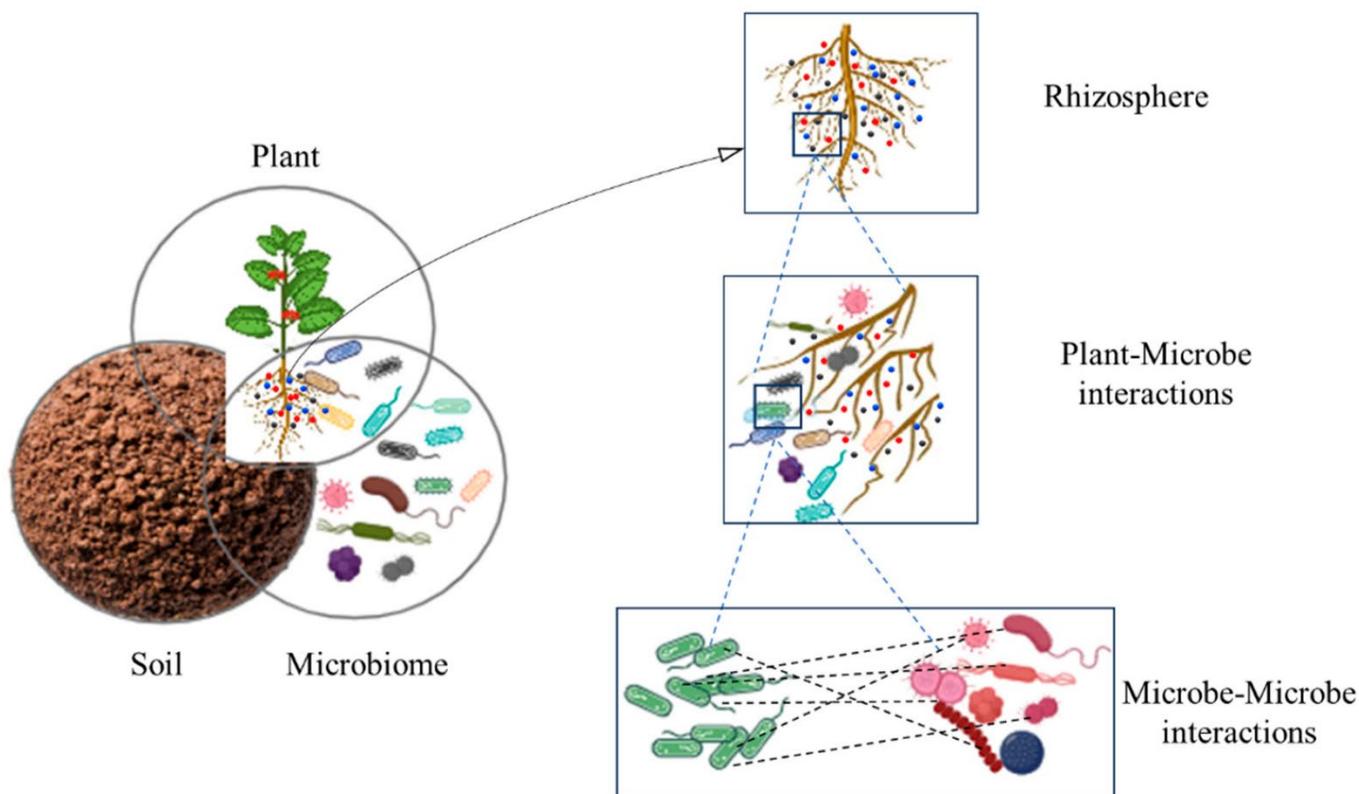
"Fig. 2: Interactions of rhizospheric microbes with plant roots stimulating plant growth and significantly improving drought tolerance: i) root-microbe interaction, ii) synthesis of phytohormones, and iii) production of primary and secondary metabolites. Root-microbe interaction leads to the secretion of root exudates and exopolysaccharides (EPS), which results in improved water retention around plant root. Drought sensing by plant roots leads to the activation of CLE25 peptide that triggers abscisic acid (ABA) accumulation, inhibiting stomatal opening to avoid dehydration. Similarly, indole acetic acid (IAA) and brassinosteroids (BRs) improve water and nutrient uptake under drought stress. Primary and secondary metabolites also participate in improving plant fitness and yield under stress. AMF = arbuscular mycorrhiza fungi."

Source: Muhammad Aslam, Mehtab & Okal, Eyalira & Idris, Aisha & Zhang, Qian & XU, Weifeng & Jk, Karanja & Wani, Shabir & YUAN, Wei. (2022), "Rhizosphere microbiomes can regulate plant drought tolerance," *Pedosphere*. 32. 61-74. 10.1016/S1002-0160(21)60061-9.

Of note, is the production of water from degrade and depolymerized Sugarcane Bagasse by White Rot Fungi and other parts of the natural microbial biome. IFUS contends, based on reports from those applying SupremeAG™ with Nutri-Mastic as a mulch and/or soil amendment, that lower hydration requirements are achieved.

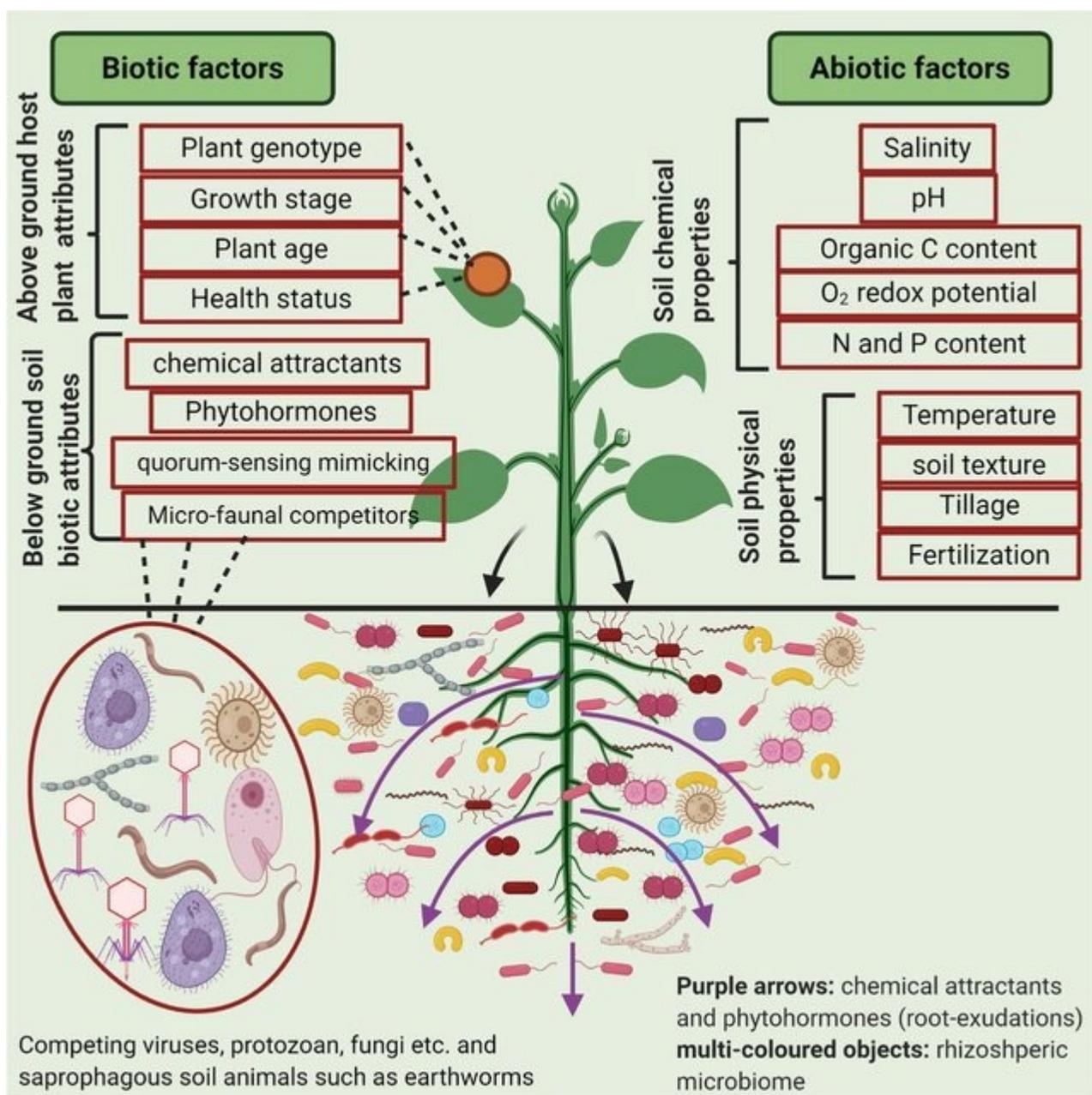
Furthermore, we find more evidence of the critical nature of the soil biome in information provided by, Tharanath, A.C.; Upendra, R.S.; Rajendra, K. *Soil Symphony: A Comprehensive Overview of Plant–Microbe Interactions in Agricultural Systems*. *Appl. Microbiol.* 2024, 4, 1549-1567.
<https://doi.org/10.3390/applmicrobiol4040106>

"Abstract: The rhizosphere, a narrow region of soil surrounding plant roots, is an environment rich in microbial diversity that profoundly influences plants' health, growth, and agricultural productivity. This microbial community, known as the rhizosphere microbiome, consists of a complex array of bacteria, fungi, archaea, and other microorganisms that engage in complex interactions with plant roots. These microorganisms contribute to nutrient cycling, mineral uptake facilitation, and protection against soil-borne pathogens, thereby promoting plant growth and resilience towards biotic and abiotic stresses. Additionally, microbial signaling molecules, including phytohormones such as auxins, cytokinin, gibberellins, ethylene, and abscisic acid, play a pivotal role in regulating these interactions by modulating plants' responses to environmental stressors. Recent advancements in microbiomics have enabled a deeper understanding of the rhizosphere's diversity, composition, and functions, paving the way for more sustainable agricultural practices. By harnessing the potential of the rhizosphere microbiome, innovative strategies can be developed to reduce dependency on synthetic agrochemicals, enhance soil fertility, and increase crop yields. This review discusses the diversity and mechanisms of plant–microbe interactions, focusing on the role of microbial signaling molecules, and explores their applications in promoting agricultural sustainability. The insights gained from microbiomics studies can revolutionize farming practices by reducing dependency on chemical inputs, enhancing crop productivity, and nurturing soil health and environmental sustainability."



We continue our exploration into the microbial biome of the soil with a study performed by Bano, Saira, Wu, Xiaogang, Zhang, Xiaojun, "Towards sustainable agriculture: rhizosphere microbiome engineering" Volume 105, DO: 10.1007/s00253-021-11555-w, Journal of Applied Microbiology and Biotechnology 2021/10/01

"Soil microbiomes are extremely complex, with dense networks of interconnected microbial species underpinning vital functions for the ecosystem. In advanced agricultural research, rhizosphere microbiome engineering is gaining much attention, as the microbial community has been acknowledged to be a crucial partner of associated plants for their health fitness and yield. However, single or combined effects of a wide range of soil biotic and abiotic factors impact the success of engineered microbiomes, as these microbial communities exhibit uneven structural and functional networks in diverse soil conditions. Therefore, once a deep understanding of major influential factors and corresponding microbial responses is developed, the microbiome can be more effectively manipulated and optimized for cropping benefits. In this mini-review, we propose the concept of a microbiome-mediated smart agriculture system (MiMSAS). We summarize some of the advanced strategies for engineering the rhizosphere microbiome to withstand the stresses imposed by dominant abiotic and biotic factors. This work will help the scientific community gain more clarity about engineered microbiome technologies for increasing crop productivity and environmental sustainability."



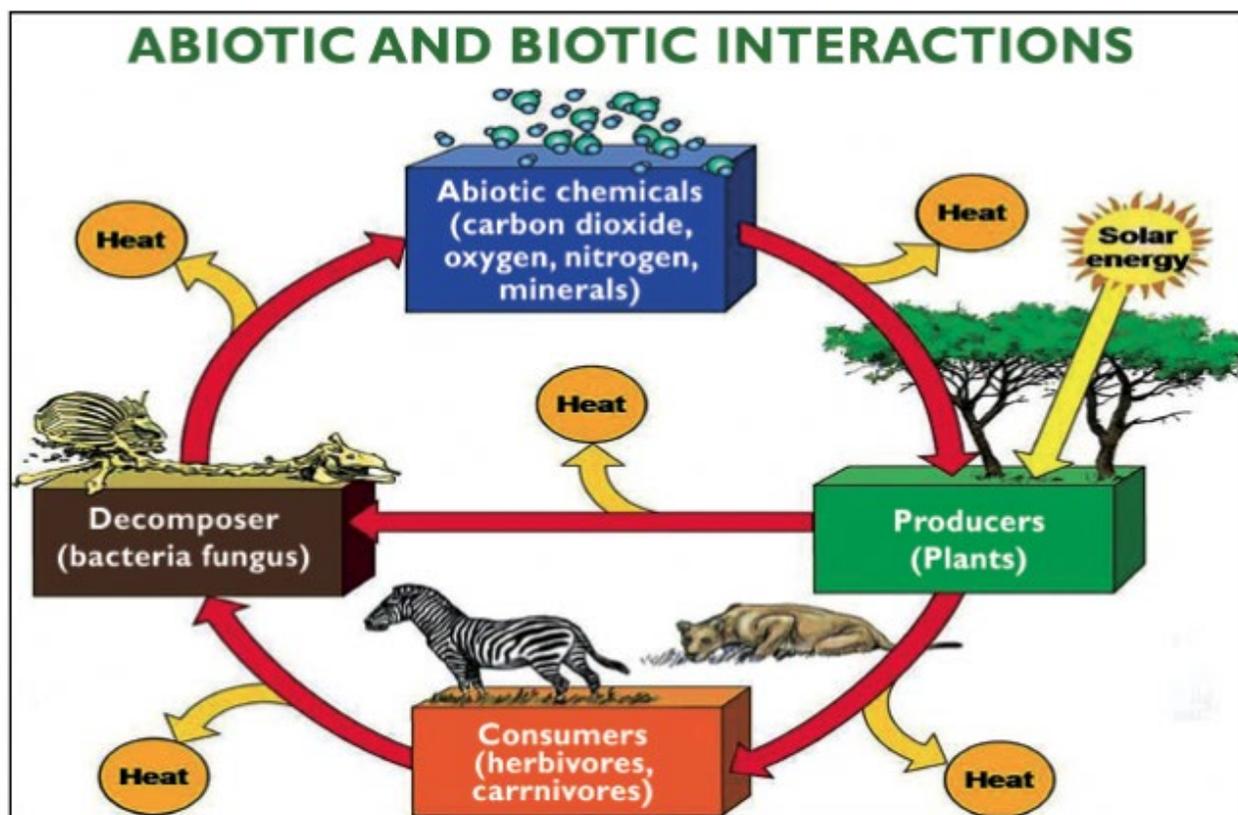
S. Bano, et.al. provide "Key points: Individual or combined effects of soil biotic and abiotic variables hamper the implementation of engineered microbiome technologies in the field.

- As a traditional approach, reduced-tillage practices coinciding with biofertilization can promote a relatively stable functional microbiome.
- Increasing the complexity and efficiency of the synthetic microbiome is one way to improve its field-application success rate.
- Plant genome editing/engineering is a promising approach for recruiting desired microbiomes for agricultural benefit."

Again, where these studies provide invaluable information, insight, and data, IFUS contends that SupremeAG™ with Nutri-Mastic™ holds incredible promise as an

eco-friendly and cost-effective product and technology...one that does not require human intervention in "Plant genome editing/engineering", but one that may in fact be enabling "Mother Nature" to do this naturally.

In Summary, we offer a pictorial representation of the "Components of Ecosystem: Abiotic & Biotic Components"



Source: <https://www.nextias.com/blog/components-of-ecosystem/>

IFUS contends that SupremeAG™ with Nutri-Mastic™ has demonstrated efficacy in qualitative trials performed to date in an eco-friendly, cost-effective, and sustainable manner through the use of an abundant biomass material...Sugarcane Bagasse. In doing so, Abiotic and Biotic Interactions can be managed by "Mother Nature" vs. through human intervention. Where in noble pursuit, the complex nature of any given biome (or for that fact biosphere) seems far too complex to provide solutions that mimic this complex array of chemical and physical moieties. IFUS holds that SupremeAG™ with Nutri-Mastic™ with its all natural ingredients is simply allowing for the diverse microbial biome to create an environment by which healthy plants, trees, and shrubs result.

SupremeAG™ contains Iron plus 72-Ionic Minerals to include N, P, and K.

In consideration of all the information presented in this White Paper thus far (as well as the other White Papers provide on the IFUS Website), one must beg the question as to why IFUS contends that the SupremeAG™ with Nutri-Mastic™ formulation is plausibly different.

Here's is an attempt to provide that insight:

- IFUS uses an annually renewable biomass feedstock that had little use presently; that being, Sugarcane Bagasse.
 - Sugarcane Bagasse is a unique grass that produces high-levels of sucrose.
 - Sucrose is a unique sugar that contains a glucose and fructose molecule in a 1-to-1 ratio.
 - Sugarcane Bagasse contains within itself a myriad of natural phytochemicals, vitamins, minerals, fibers, and more (other sugars like dextran, ISP, etc.)
 - Sugarcane Bagasse is high in lignin and contains S-, G-, and H-lignins.
 - Sugarcane Bagasse is noted for having Humic Substances. However, the recalcitrant lignin in Sugarcane Bagasse makes is less than desirable as a mulch or soil-amendment.
- The ingredients in Nutri-Mastic™ as well as Carob are naturally sourced and are processed in natural methods.
- The formulation of Nutri-Mastic™ contains Chios Mastic Gum (uniquely mixed in water and naturally sourced ionic minerals).
- And, less not forget the microbial biosphere with a multitude of microbial biomes thrive in Sugarcane Bagasse.

Nutri-Mastic™ in SupremeAG and Soil Biome / White Rot Fungi

When Nutri-Mastic™ and Carob are added to Sugarcane Bagasse, then processed through the IFUS Proprietary Processing Methods, "Mother Nature" takes over and does "Her" thing...in an eco-friendly, cost-effective, and timely manner as shown in the picture below.



The result is SupremeAG™. And, when SupremeAG™ with Nutri-Mastic™ is added as a mulch and/or soil amended INPUT to respective plants, trees, and/or shrubs (with Best Gardening Practices), then the OUTPUT is being reported to be improved Performance Outcomes.

CONCLUSION:

We begin with the notion of "Soil: The Foundation of Nutrition" per the illustration below. This simplified, yet complex diagram attempts to illustrate the actions, interactions, and relationships (both inter- and intra-) that create a maze of inter-dependencies that allow for the health, and unfortunately more so the illness of what is believed to be over 2-Billion of the roughly 8.25-Billion humans from "micronutrient deficiencies." This affects more than 25% of the present global population...the socio-economic consequences of which are staggering.



Source: https://talborne.co.za/wp-content/uploads/2023/02/a-bc275e_page-0001-1024x724.jpg

We do find interesting studies recently published that continue to challenge both historical and contemporary thinking as to plant based nutrients.

Fazal Sultanbawa and Yasmina Sultanbawa pose an interesting group of questions worthy of consideration in their treatise, "Mineral nutrient-rich plants – Do they occur?" (Applied Food Research, Volume 3, Issue 2, 2023, 100347, ISSN 2772-5022, <https://doi.org/10.1016/j.afres.2023.100347>.) (<https://www.sciencedirect.com/science/article/pii/S2772502223000847>)

"Abstract: Mineral composition of plants is influenced by the growing environment, plant genetics and management practices. This affects claims about nutritional value of food plants. This review attempts to highlight the various factors associated with absorption of mineral nutrients by plants. Influences of soil factors which can be physical, chemical, and biological are identified. Environmental factors such as temperature, seasonality, and CO₂ levels as well as plant factors such as genetics, variety, root architecture, stage of growth etc. affect absorption of mineral nutrients. The role of agronomy in the form of fertilizer inputs, irrigation, plant densities etc. is

also a significant factor in the availability and absorption of mineral nutrients. The practical significance of such a critical review of mineral absorption arises due to its implications for health and nutrition and the various claims made for nutritional value and dietary interventions. It is also of value to food producers to ensure that their produce meets the expectations of consumers who rely on such foods for diet and wellbeing. The topic is also of significant national and global importance for food policy and nutrition planning."

Sultanbawa and Sultanbawa challenge and explore the nature, relevance, accuracy, and precision of our collective present thinking. In this, they challenge not only said thinking, but the data we are considering, the manner in which we test and measure, our testing designs, and our conclusions.

IFUS contends that this is indeed a worthy challenge, as it asks (from our perspective) fundamental questions:

1. What constitutes actual nutritive value of the plants (and more broadly the foods) that we consume?
2. What impact is this information (or lack thereof) having on the health and well-being of life on the planet (as well as the planet itself)?
3. Are there solutions that are consistent with the "Natural Order" that substantively allow for said "Natural Order" so as to produce viable outcomes for plants, animals, and humans in an eco-friendly and cost-effective manner?

IFUS contends that it has plausible scientific evidence that SupremeAG™ with Nutri-Mastic™ may in fact provide beneficial answers to these key questions.

These questions will be explored in further White Papers.