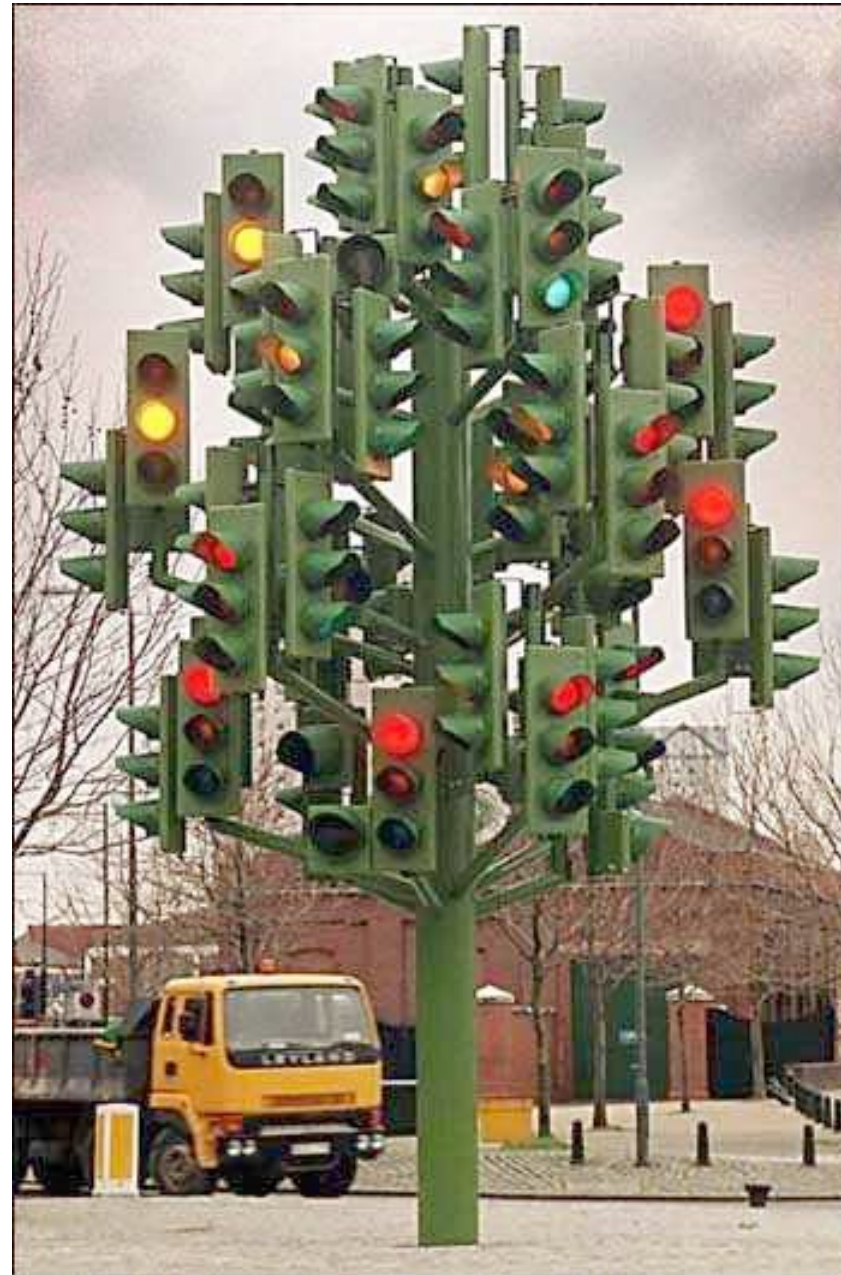


# Humic Substances and Soil Life in Agriculture



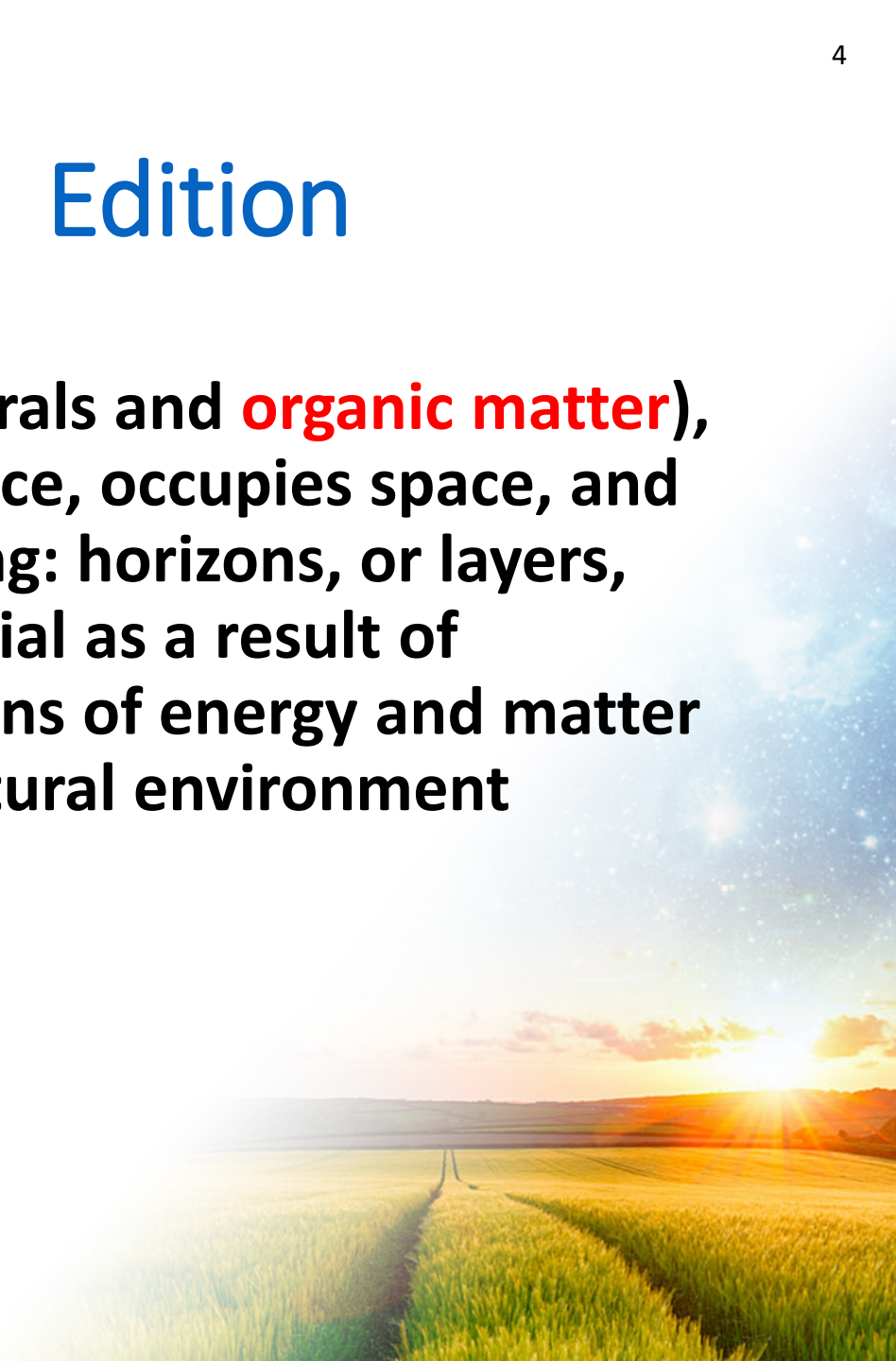


The Power Beneath Your Plants



# Soil Taxonomy, Second Edition

**Soil:** a natural body comprised of solids (minerals and **organic matter**), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment



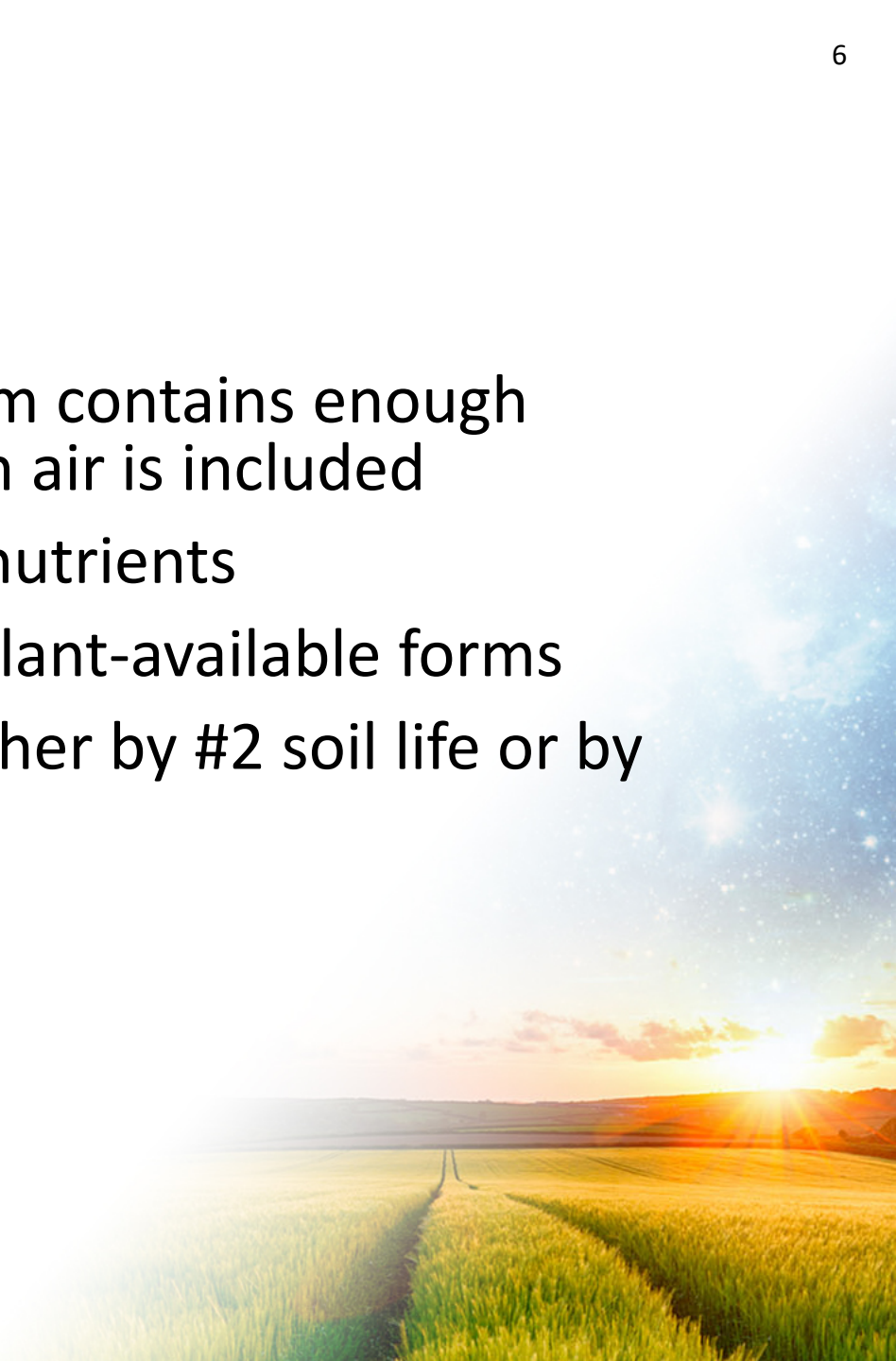


# 3 Fundamentals of Soil Life

- **Fundamental components to a healthy productive soil:**
  - 1) **Essential mineral nutrients**
  - 2) **Beneficial soil micro-organisms**
  - 3) **Organic matter in the form of Humus**
- **Add water & oxygen - and the system is prepared to function optimally to support healthy plants**

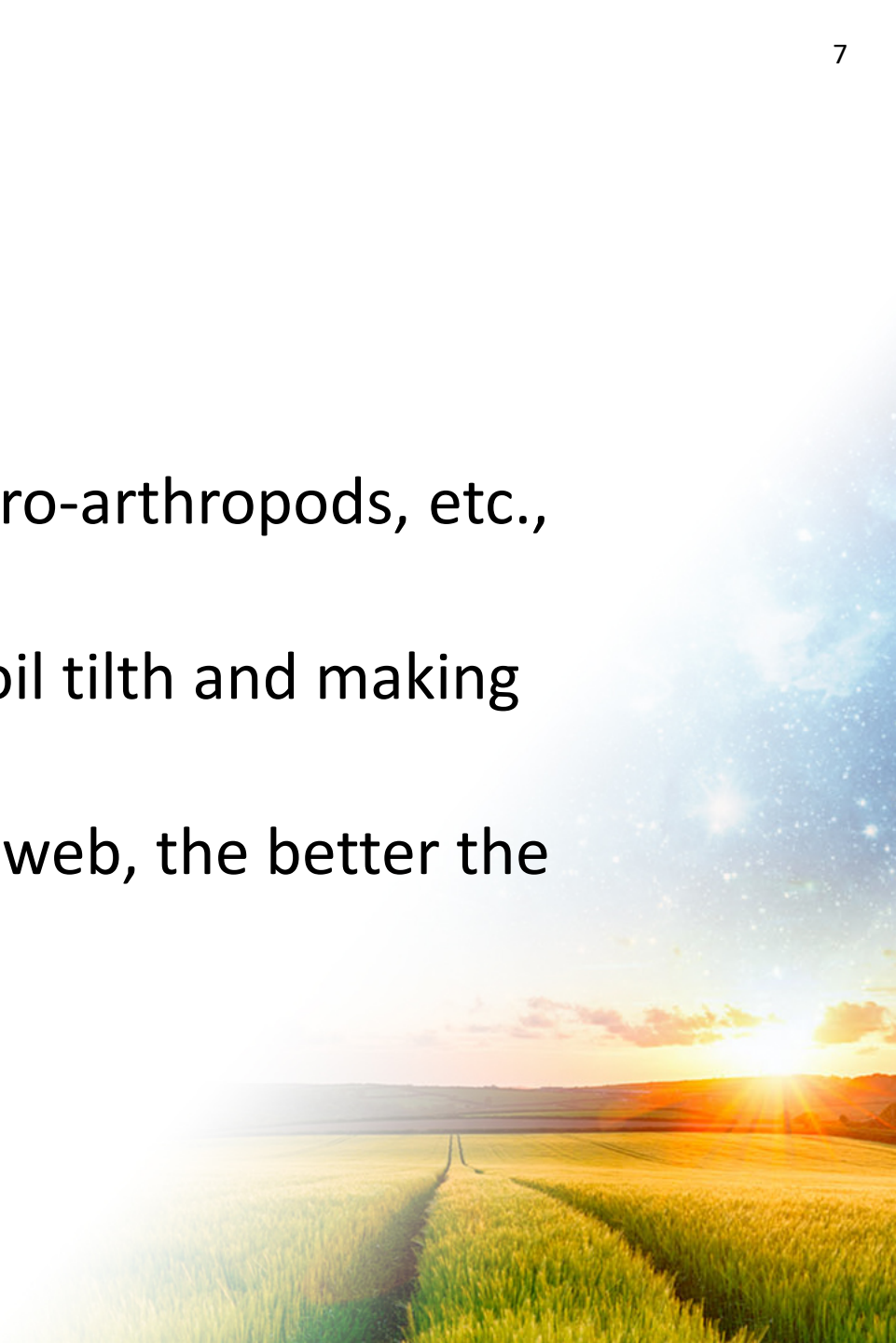
# 1) Mineral Nutrients

- It can be argued that any soil in which we farm contains enough mineral nutrients to raise a crop when N from air is included
- Geology of the parent material provides the nutrients
- These nutrients, however, are not always in plant-available forms
- Nutrients in organic forms are complexed, either by #2 soil life or by #3 humic substances



## 2) The Soil Food Web

- Microbes: bacteria & fungi
- Higher Life Forms: protozoa, nematodes, micro-arthropods, etc., comprise the soil food web
- All these critters do the work of enhancing soil tilth and making nutrients available to plants in organic form
- The healthier and more diverse the soil food web, the better the system works – fewer pathogens
- Diversity is key!



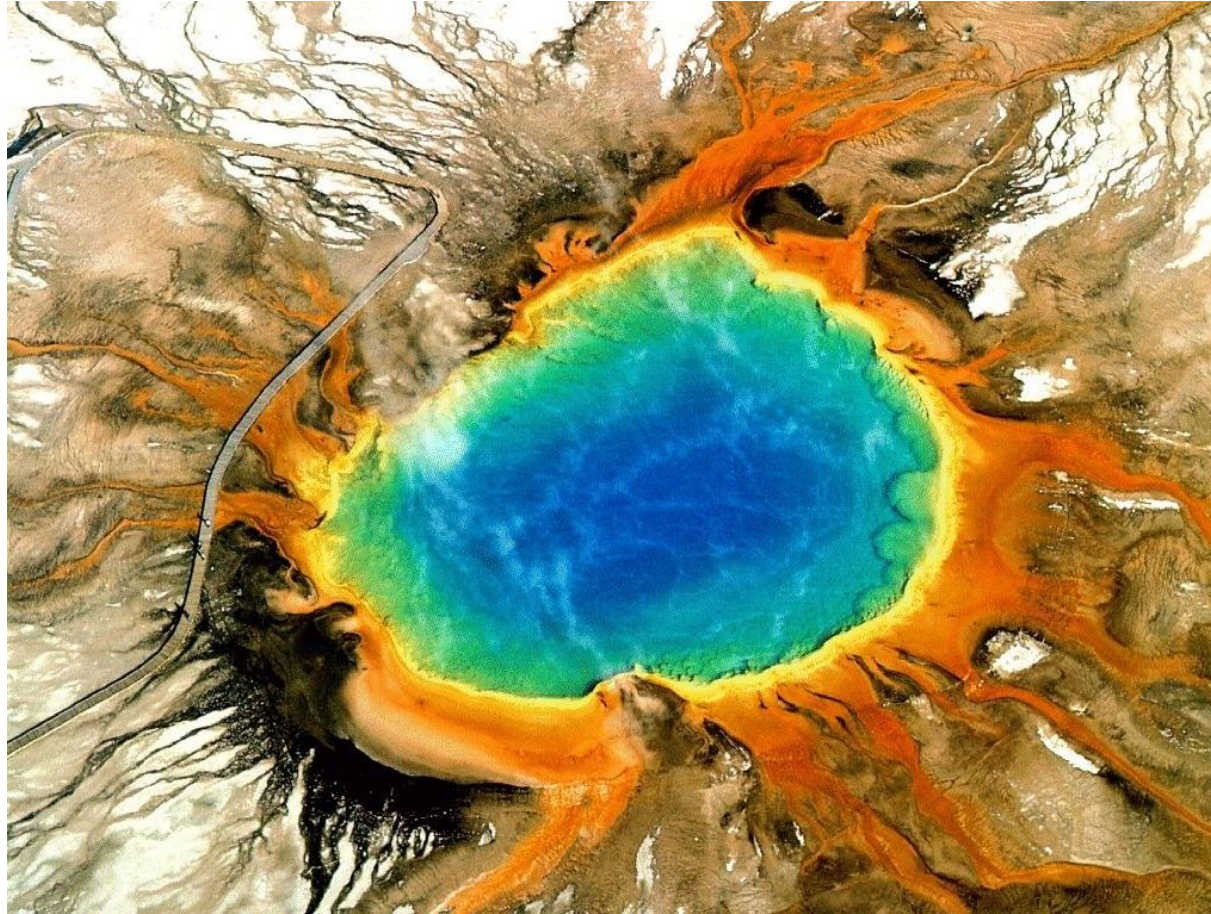


# Importance of Soil Life

- “Because of the important contributions made by bacteria to the fertility level of the soil, life of higher plants and animals could cease if the functions of the bacteria were to fail” – *A&L Agronomy Handbook*
- “Microbial activity (biology) drives chemistry, including pH and ultimately determines fertility” – Dr. Elaine Ingham



# Grand Prismatic Spring



## 3) Humus

- Provides the ideal environment for the Soil Food web – diversity & fuel
- Stimulates microbial activity, which is at the bottom of the food chain
- Microbes convert mineral nutrients to organic forms and also create additional humus from plant residue, etc.
- This is the “system” for optimal performance



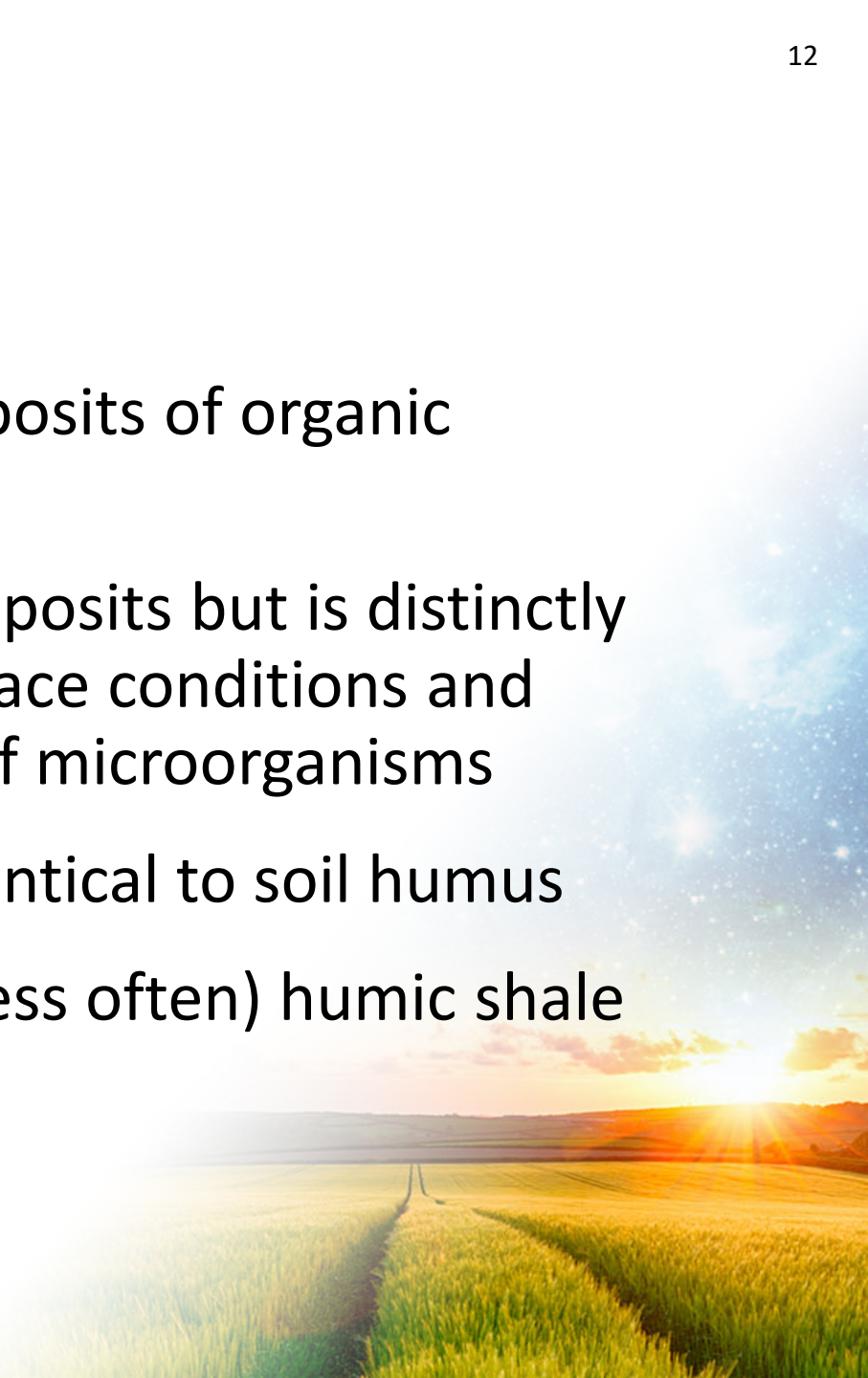
# Humates and Humic Acids

- replace soil carbon
- chelate N
- catalyst to jumpstart proper, healthy humification
- provide the essential substrate for biology



# Humates

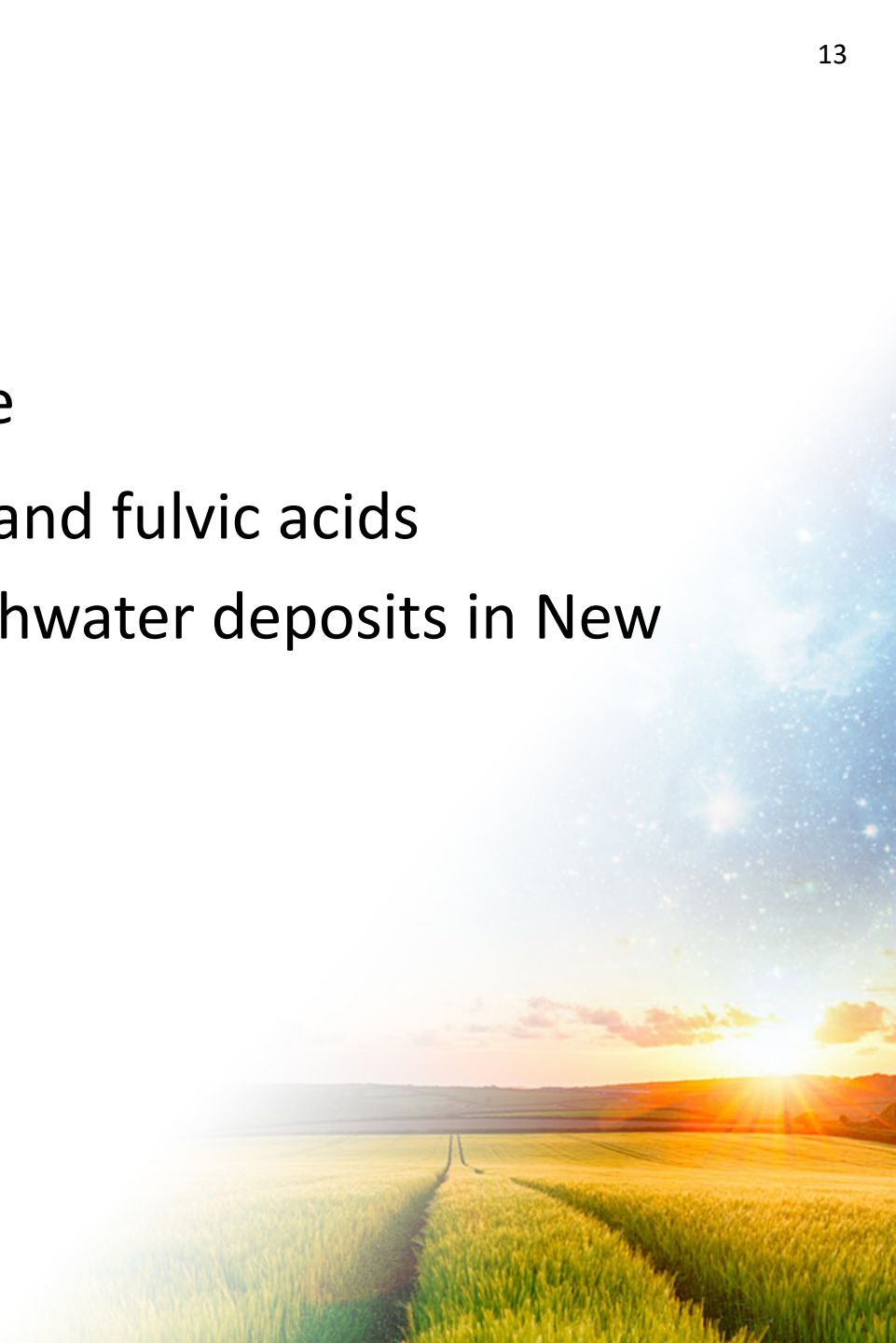
- Humates are naturally occurring geological deposits of organic materials
- This organic material is associated with coal deposits but is distinctly different in that it has been raised to near-surface conditions and highly oxidized by weathering and the action of microorganisms
- The end result is a material with properties identical to soil humus
- Also known as oxidized lignite, leonardite or (less often) humic shale





# Humates (continued)

- The oxidation process removes any fuel value
- Creates and concentrates extractable humic and fulvic acids
- Highest quality humates are mined from freshwater deposits in New Mexico, high in fulvic acid fraction
- Humates are organic













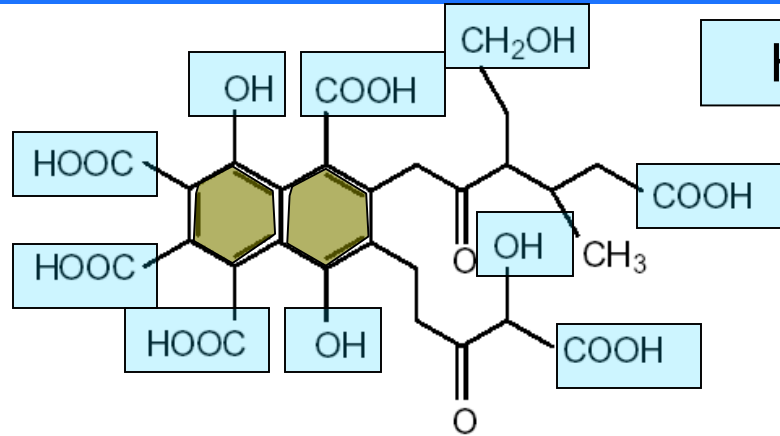
# Humate Chemistry

Humates can be fractionated to yield three major components, based on solubility in acids and bases, and by molecular weight (size)

- Fulvic Acids
- Humic Acids
- Humin



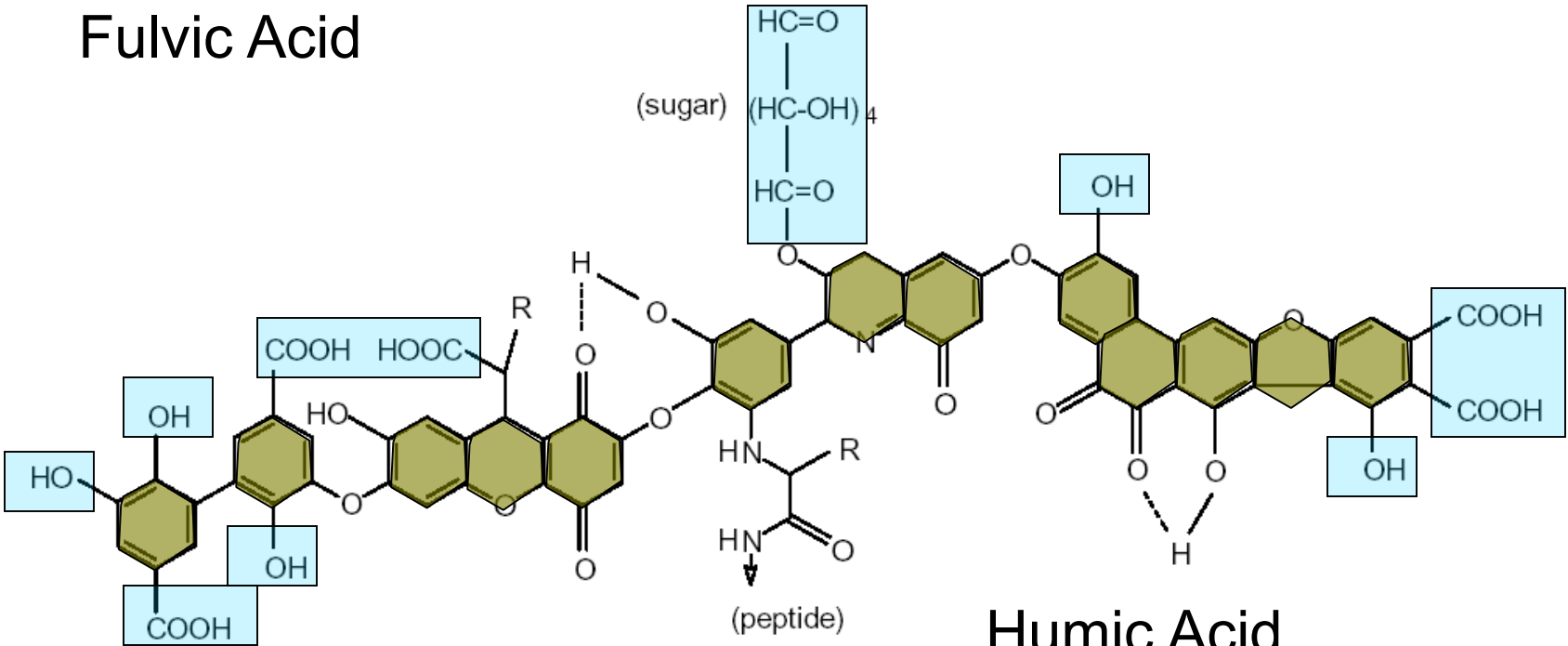




Hydrophilic – Keeps Water Soluble

Hydrophobic – Absorbs Organics (hydrocarbons)

### Fulvic Acid



### Humic Acid

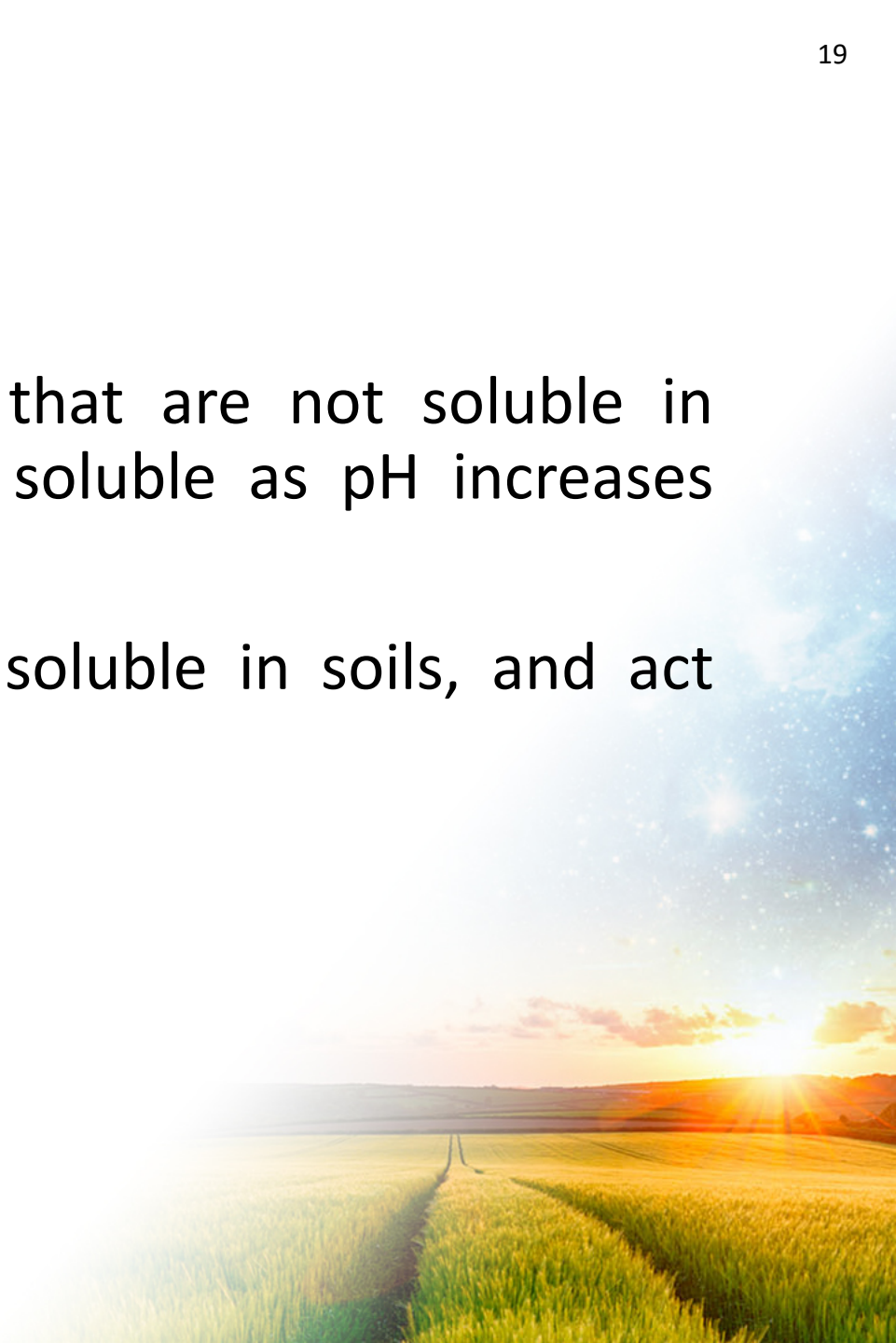
# Fulvic Acids

- Have the strongest hormone-like stimulatory effect on plants and soil microbes
- Fulvic acids stimulate
  - root and top growth
  - nutrient uptake
  - chlorophyll production
  - but do not feed most soil microorganisms
- Fulvic Acids are **“Plant Active”**



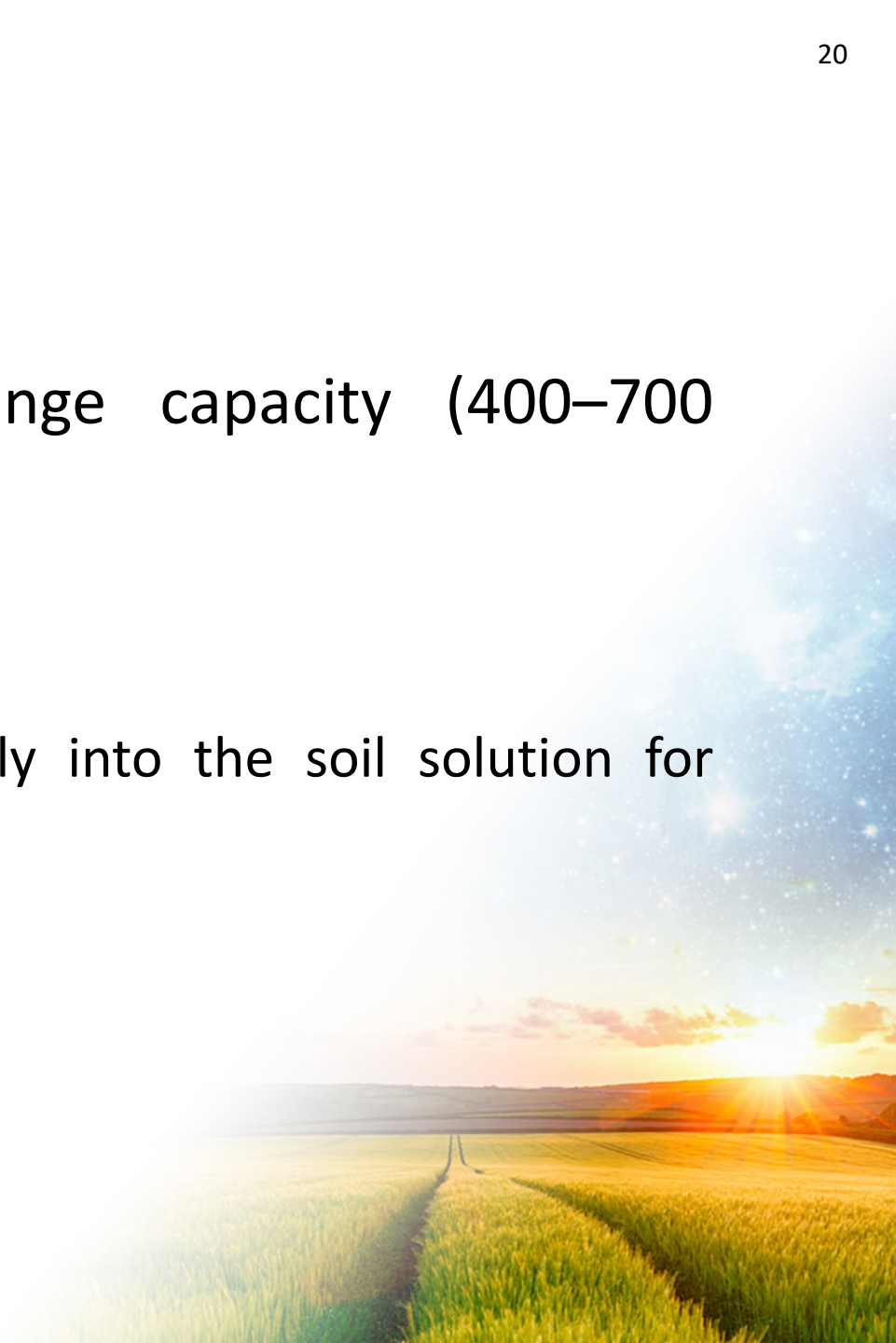
# Humic Acids

- Humic Acids are large organic molecules that are not soluble in strongly acid solutions, but become more soluble as pH increases through the ranges found in soils.
- The largest humic acid molecules are not soluble in soils, and act much like the humin fraction



# Humic Acids

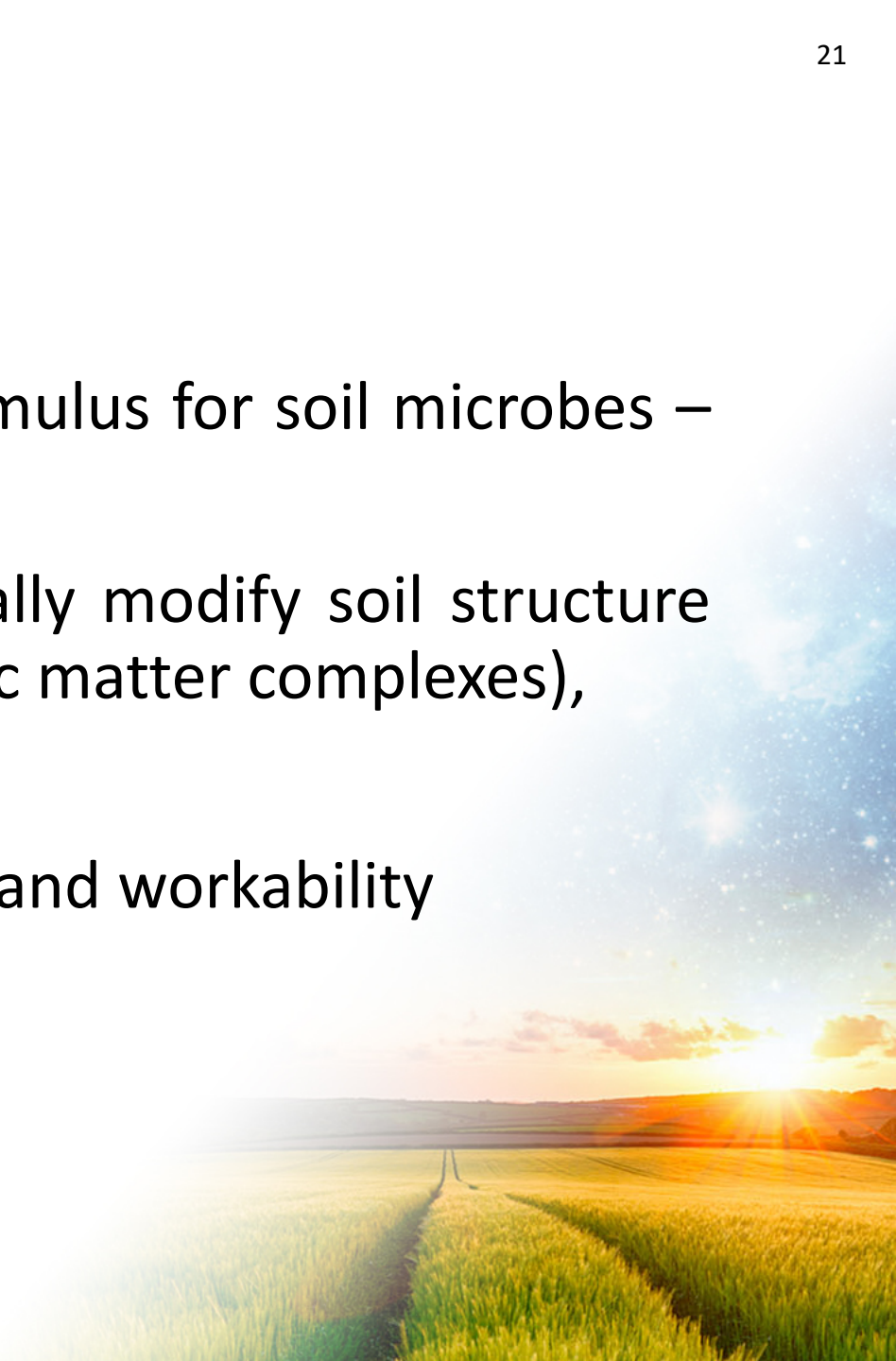
- Humic acids have a high cation exchange capacity (400–700 meq/100g),
  - Compared to soils with 5–30 meq/100g
  - They can hold lots of nutrients in reserve
  - Nutrients are released slowly but continuously into the soil solution for uptake by plants

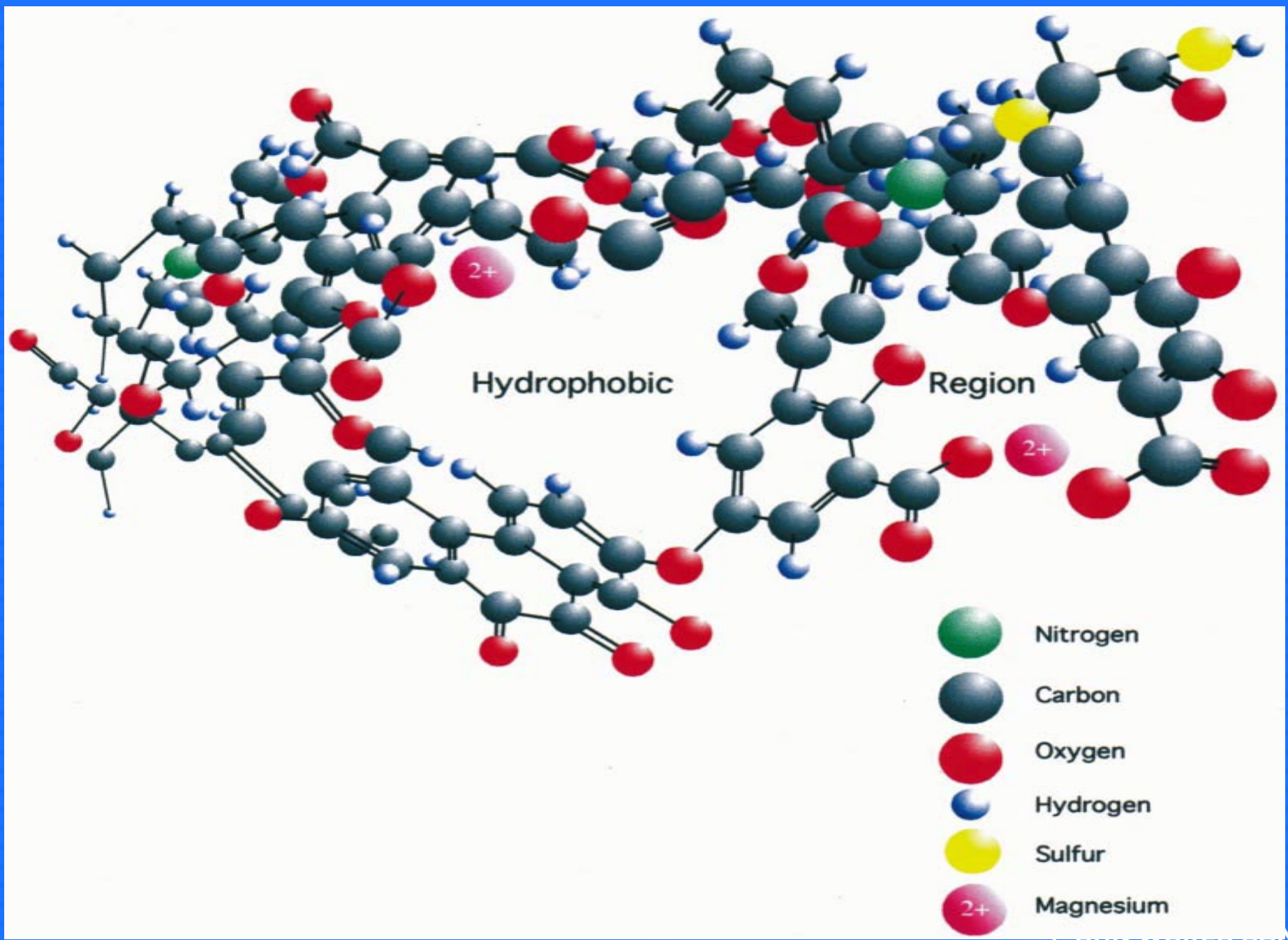




# Humic Acids

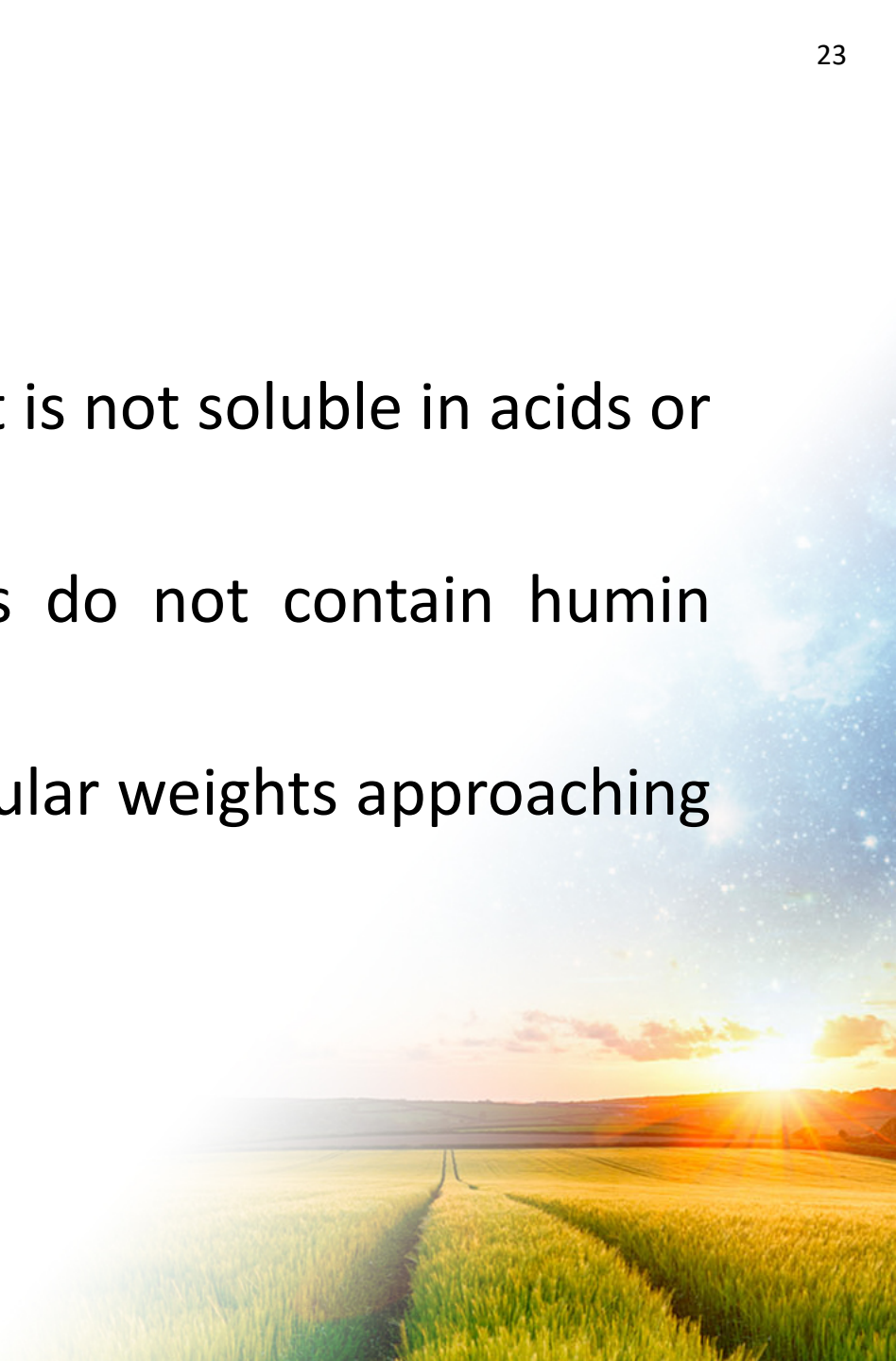
- Humic acids create the environment and stimulus for soil microbes – making them more effective
- The larger molecules of humic acids physically modify soil structure by binding soil particles together (clay-organic matter complexes),
  - increasing soil aggregate stability
- Improve water infiltration, aeration, soil tilth and workability
- Reduce crusting and erosion from runoff





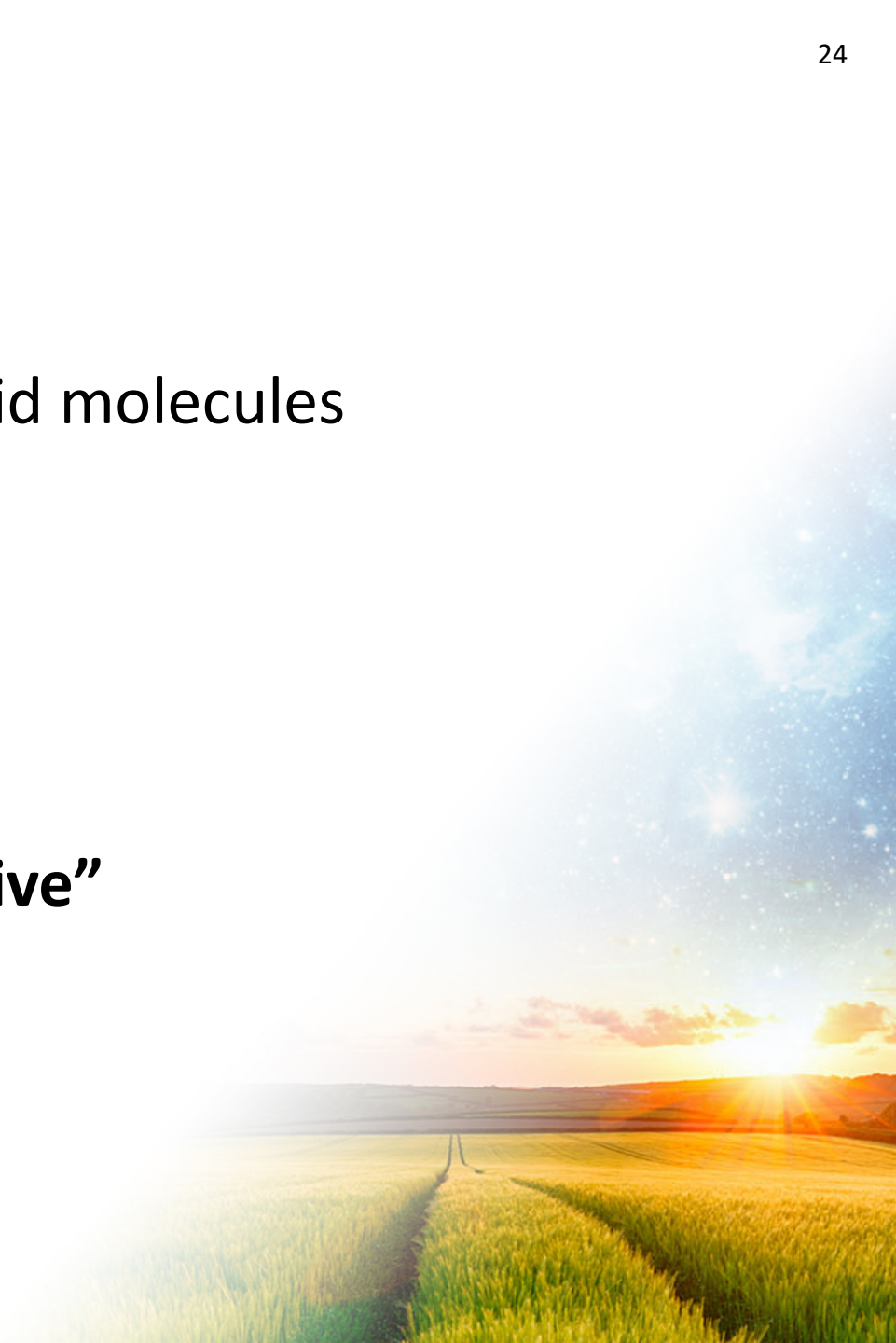
# Humin

- Humin is the organic fraction of humates that is not soluble in acids or bases
- Because of this, liquid extracts of humates do not contain humin (although Micromate does)
- Humin molecules are the largest, with molecular weights approaching a million daltons!

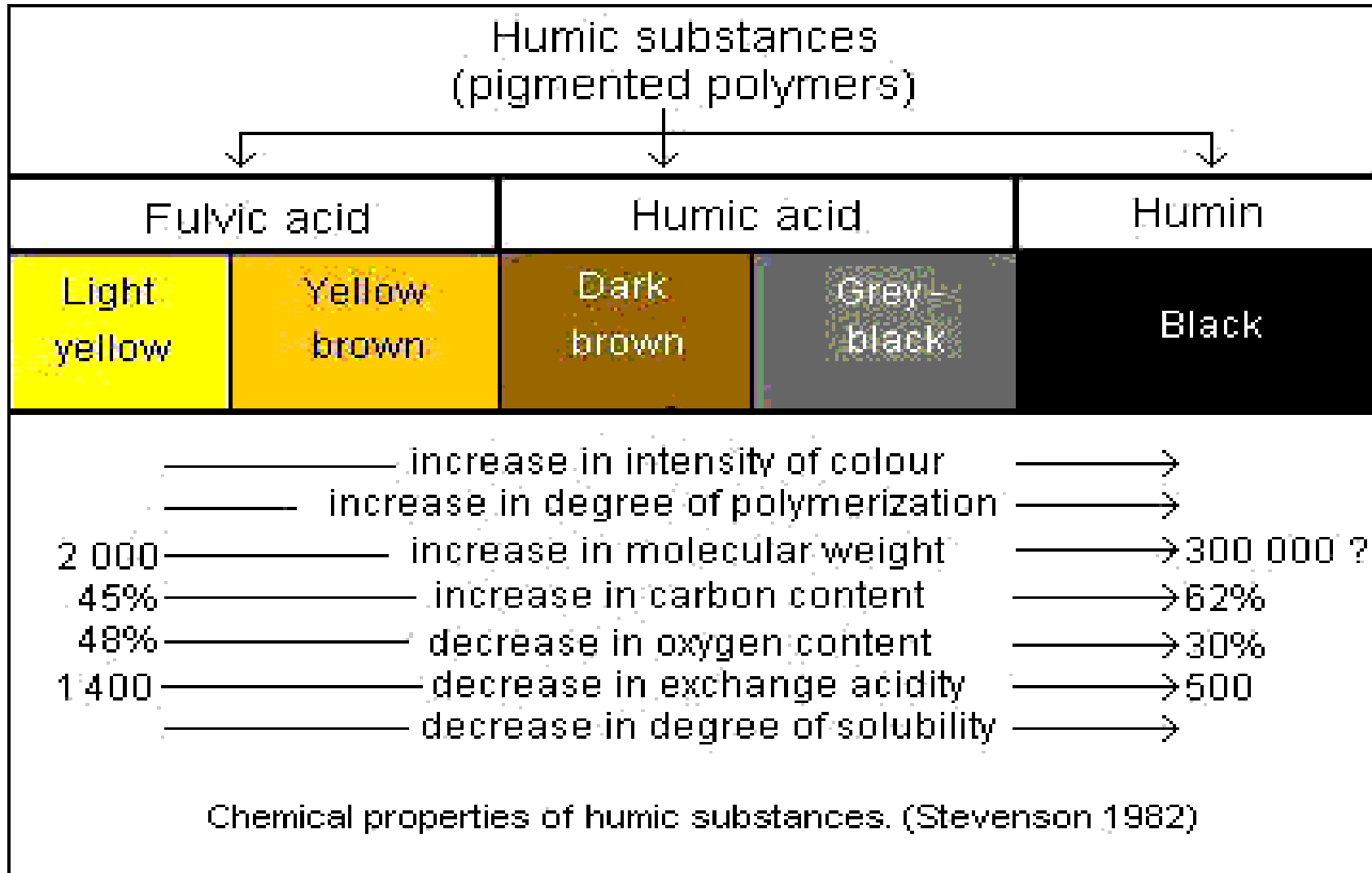


# Humin

- Humin behaves like heavier-weight humic acid molecules
  - improving soil structure (aeration; percolation)
  - increasing water holding capacity
  - increasing nutrient holding capacity
  - and sorbing toxic compounds
- Humin and heavier humic acids are **“Soil Active”**







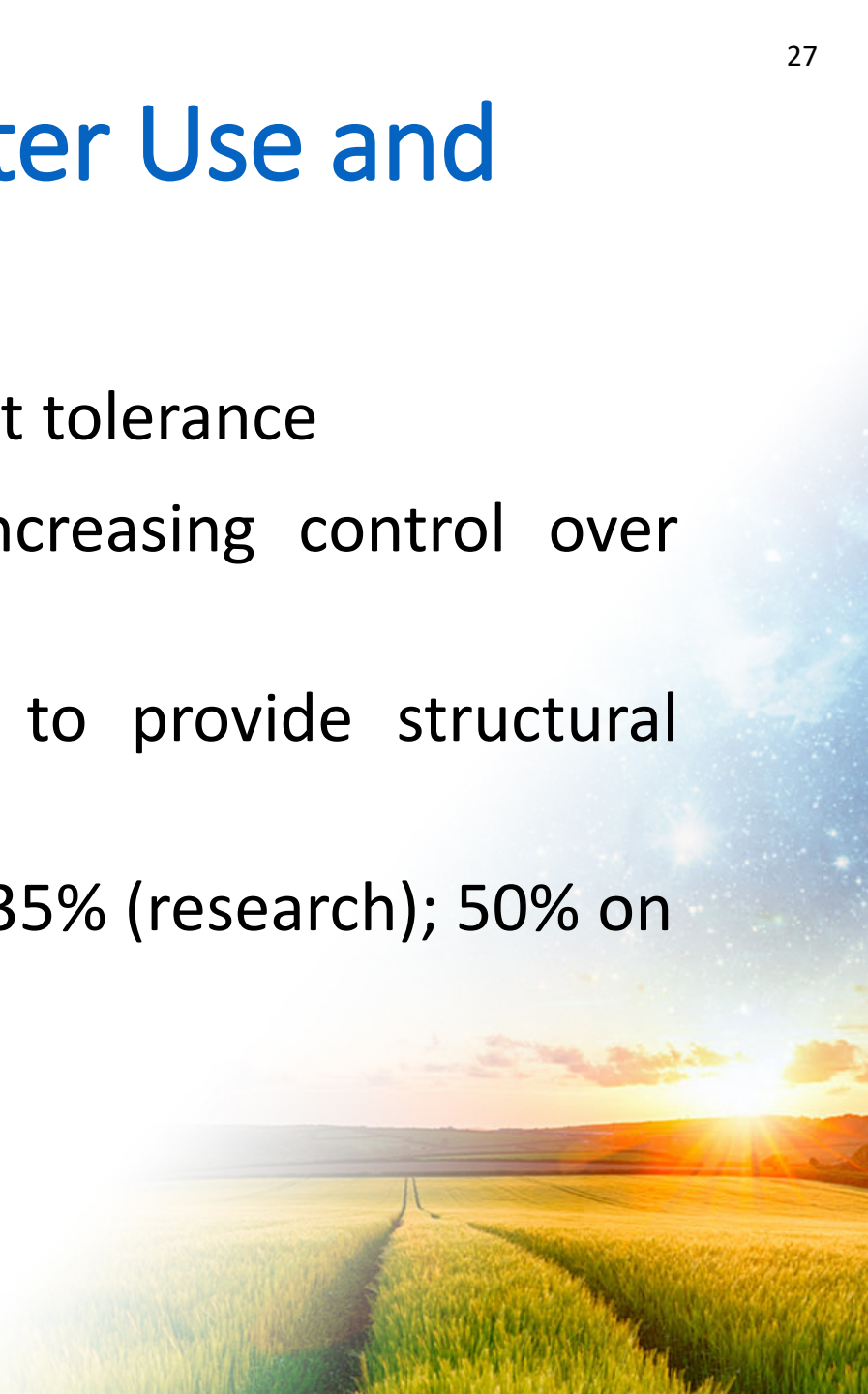
# Stimulation of Microbes

- Fulvic acid increased growth rate of rhizobium trifolii by over 200%
- Sodium humate produced 52% greater growth rate (Rhizobium trifolii) than control
- Bkardwaj and Gaur 1972



# Effects of Humates on Plant Water Use and Drought Tolerance

- Increased water-use efficiency, salt and drought tolerance
- Increased ability to exclude salt ions by increasing control over stomata, chelates/sequesters salt
- Helps plant to create heat shock proteins to provide structural support for cell plasma membranes
- Amount of water used per acre declines up to 35% (research); 50% on treated turf in the Albuquerque area



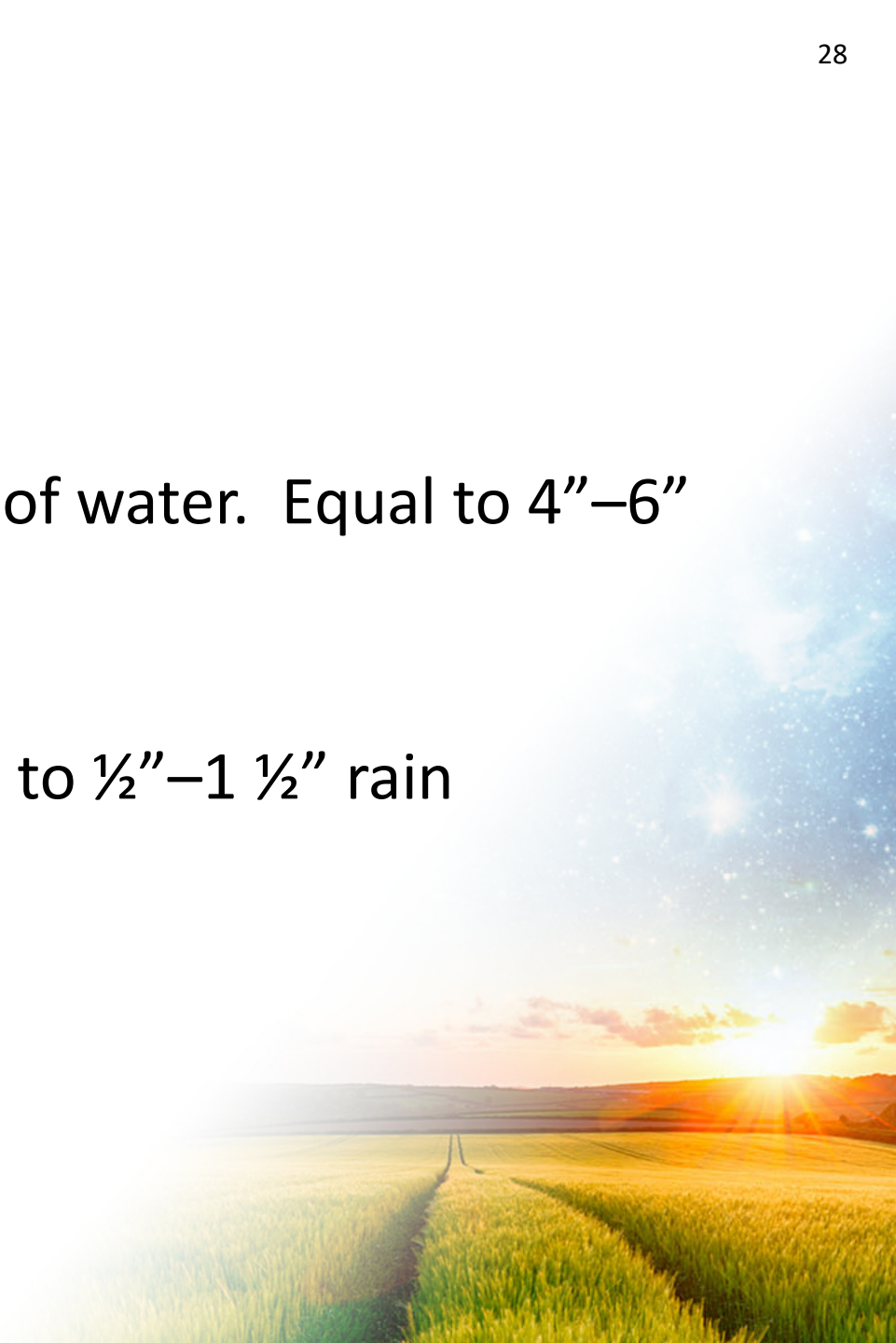
# Moisture Management

- In 100 lbs of dry Soil

4%–5% organic matter can hold 165–195 lbs of water. Equal to 4"–6" rain

1.5%–2% OM can hold only 35–45 lbs. Equal to ½"–1 ½" rain

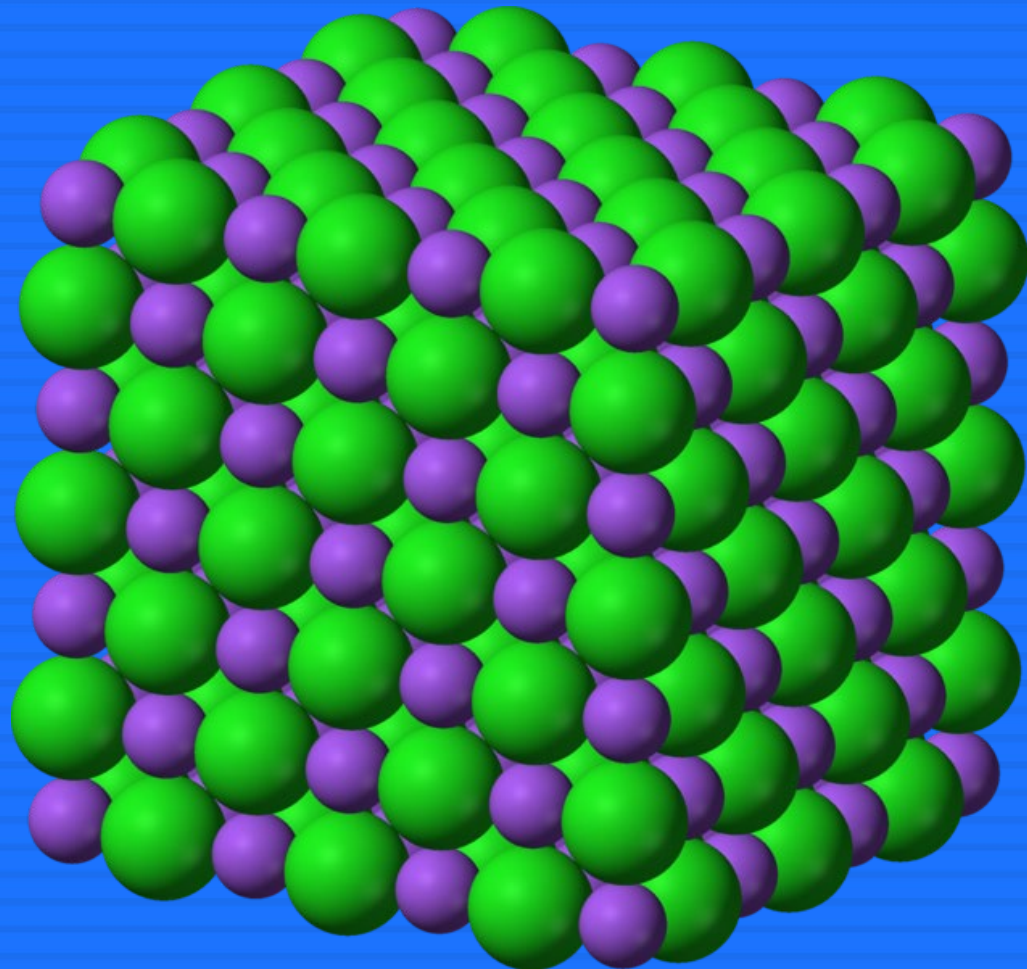
- Below 2.5% OM elements leach out





# Reduction of Harmful Levels of Salts

- HA/FA  
fractionate  
bonds between  
Na & Cl
- So do microbes!





# Humic Products

- Granular Humates: (70% HA, 55% HA & 35% HA)
  - Crushed & screened to various particle sizes
- Water Soluble Powders:
  - pH stable & OMRI-Listed versions
- Liquids:
  - 12% HA
  - 16% HA
  - FA 5% & 20% concentrate



# Let's Get Started!

- **“Humic substances are recognized by most soil scientists and agronomists as the most important component of a healthy, fertile soil.”**

*- Dr. Robert E. Pettit, Emeritus associate Professor, Texas A&M University*



THANK YOU