A landscape photograph showing a wide, flat field in the foreground with some green and yellow vegetation. In the background, a bright rainbow arches across a sky filled with heavy, grey clouds. The overall scene is dramatic and atmospheric.

# Measuring Soil Health for Vine and Wine Quality

Prepared for

## Dirt to Glass Conference - 2023

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# Soil Health

If your vineyards don't have it,  
how do you get it?  
And why should it matter?



# In terms of soil health, what do all vineyard soils need in common?





All soils have one common need – They Need Living Organisms To Help Feed What Grows There!!!





Russian soil microbiologist  
N.S. Krasilnikov judged fertility by  
counting the numbers of microbes  
present in each soil. He wrote:

***“.. soil fertility is determined by biological factors, mainly by microorganisms. The development of life in soil provides it with the property of fertility. [Fertile] soil is created by microorganisms. Where this life is dead or stopped, the former soil would become an object of geology [not biology].”***



# *HEALTHY - LIVING SOIL*

**Biomass of the organisms in the top 20 cm of living healthy soils (Pimental et al 1995)**

Organism	Kg/ ha
Bacteria	1700
Fungi	2700
Protozoa	150
Arthropods & algae	1000
Earthworms	1010





Livestock without fences?!?

Like feeding one 6,000-pound elephant beneath the soil surface per acre before your grapes get what they need!





**FEED THE SOIL/the plant's only stomach!**





**What matters most?**

**Growers need to know how to quickly treat a problem.**

**But if all you do is treat the problem without solving it, it just keeps coming back again and again!**





We need long-term solutions to stop what causes the problems, not just treating the effects.

The best solutions are not killing everything but the crop!





**Fumigation?**



The real answers to soil problems is how can we best help our soil stay alive and well to support the vines and grapes!

**SOIL LIFE = SOIL HEALTH!**

The second law of thermodynamics!

**Life only comes from life!**



# Build & Strengthen Life in the Soil







**Soil Organic Matter (SOM)**  
- primary food source  
for most soil organisms.

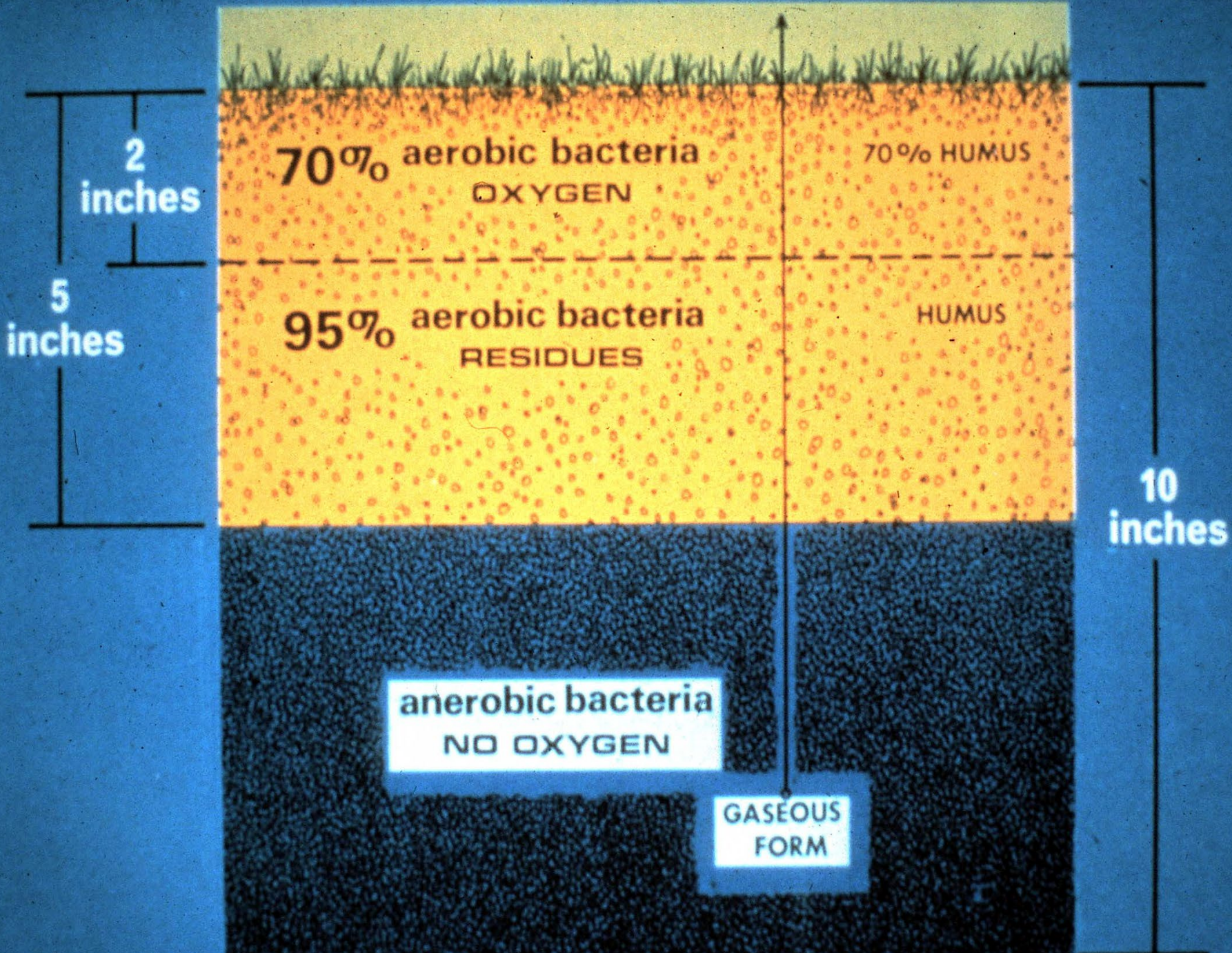
Crops with the most roots  
provide the best source of  
organic matter.



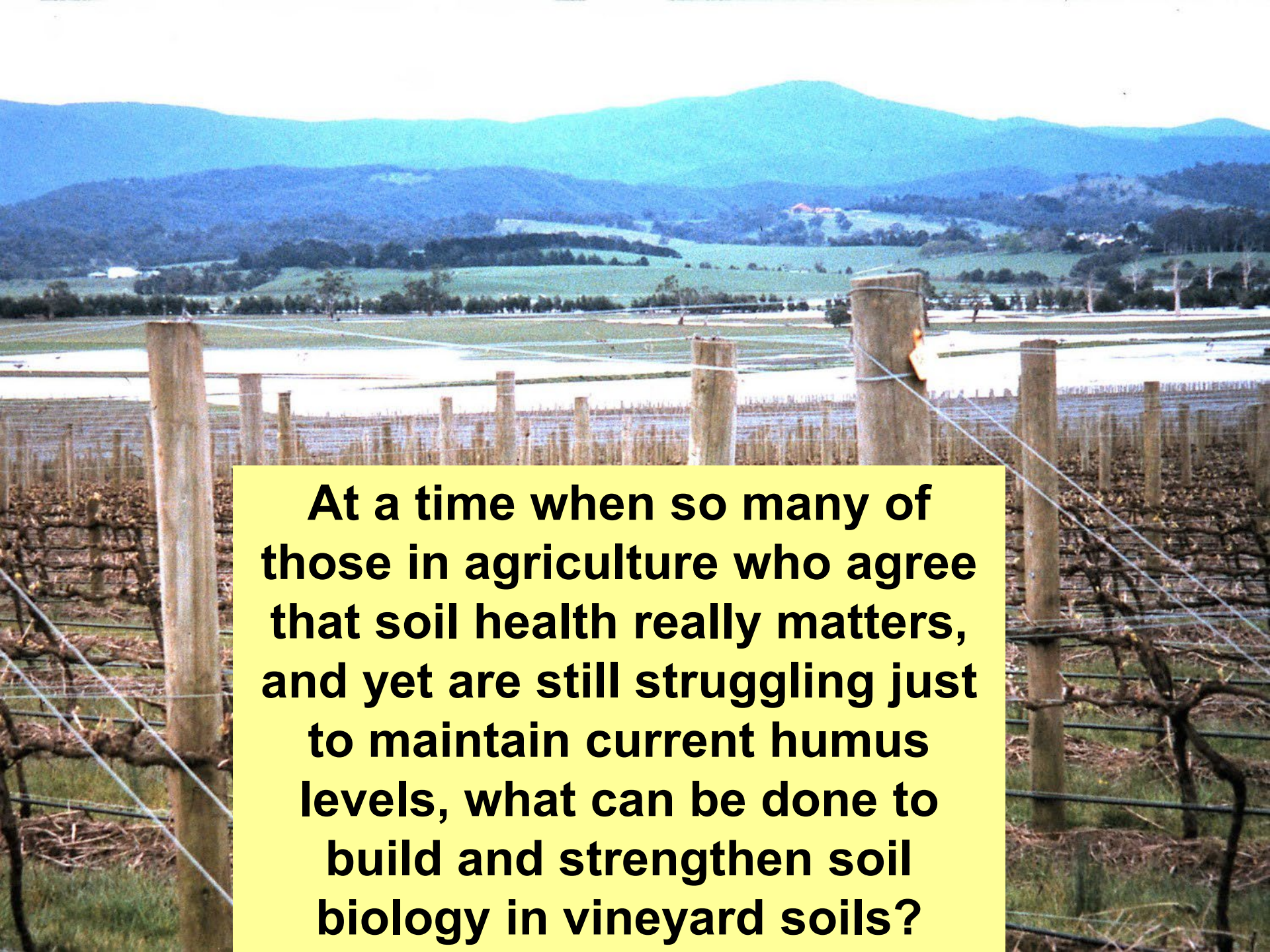
# Organic Matter Contributes to Soil Productivity In Many Ways

- ❖ Improves Physical Condition
  - ❖ Increases Water Infiltration
    - ❖ Improves Tilth
- ❖ Decreases Erosion Losses
  - ❖ Supplies Plant Nutrients
- ❖ Supplies Materials for Humus









**At a time when so many of those in agriculture who agree that soil health really matters, and yet are still struggling just to maintain current humus levels, what can be done to build and strengthen soil biology in vineyard soils?**



**To build and maintain soil humus...  
keep the soil covered!**





Continuous cover =

better soil life and health.





# Green Manure Crops

## Excellent Soil Food & Starter Fertilizer





Compost - Always get a nutrient analysis!



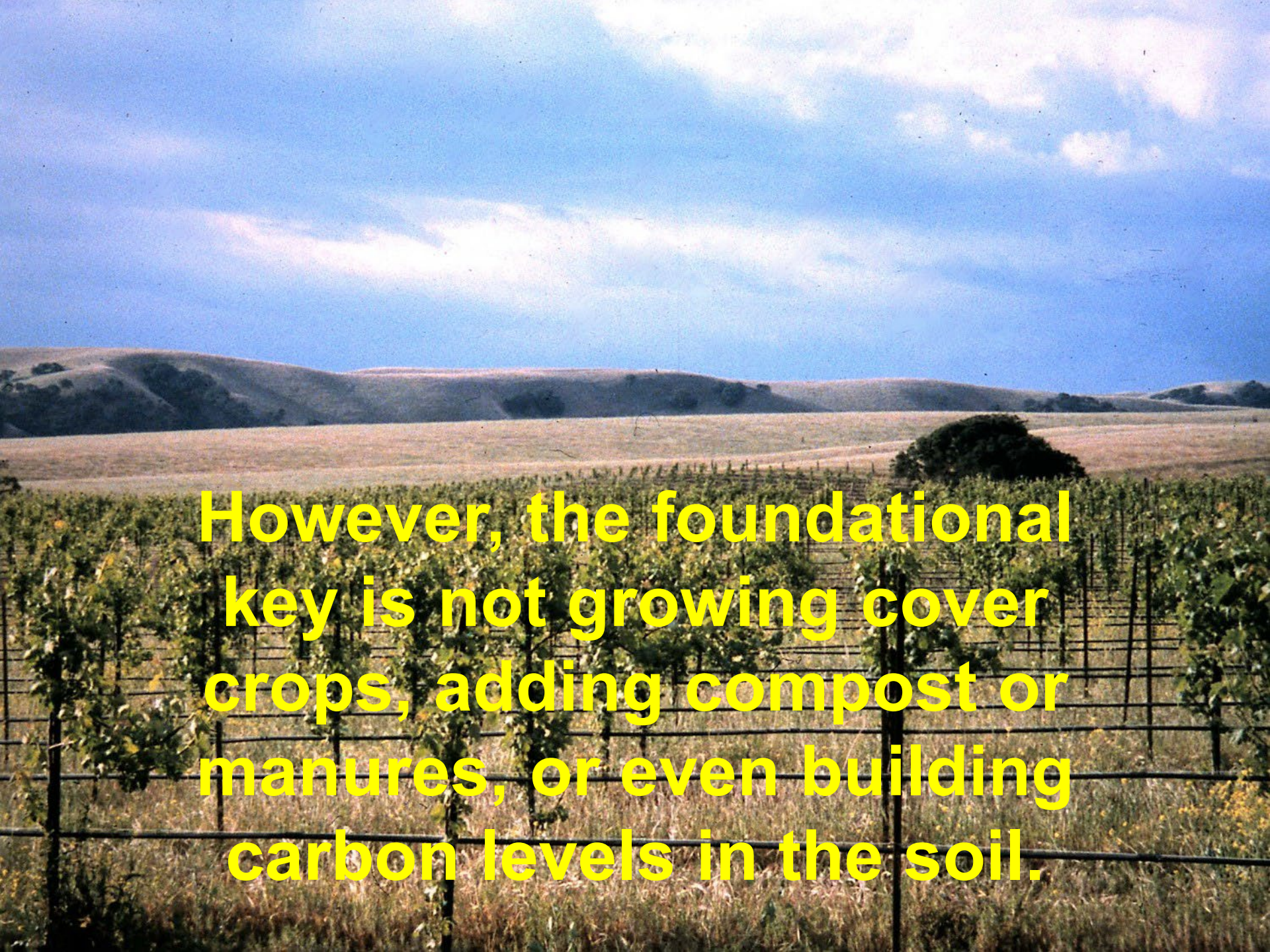


**Providing organic matter for building and maintaining humus and for providing plant nutrients is always a worthy goal.**

**It is a key to better soil biology and better crops.**





A landscape photograph showing a vineyard in the foreground with rows of grapevines. In the background, there are rolling hills under a bright blue sky with scattered white clouds. A single dark tree stands on a hill in the middle ground.

**However, the foundational key is not growing cover crops, adding compost or manures, or even building carbon levels in the soil.**



A landscape of dark brown soil mounds under a hazy sky. The soil is piled up in a series of ridges and valleys, creating a textured, undulating terrain. The sky is a pale, overcast blue-grey, suggesting a misty or overcast day. The overall scene is one of a large-scale soil management or construction project.

**All of these can be helpful practices. They are all useful tools for soil improvement.**

**But never confuse the use of soil improvement methods as being the best answers to good soil health and the best fertility.**



A landscape photograph showing a series of dark brown, terraced soil mounds in the foreground and middle ground. In the lower-left corner, a stream flows over a bed of grey rocks. In the background, a row of tall, thin, bare trees stands against a bright sky. The text is overlaid in the center of the image.

**These practices may help feed the living organisms in our soils, but they are not the true foundation on which to build soil health.**



**There is still something else  
that is more important for  
achieving true soil health in a  
vineyard and for growing the  
best vines and grapes that  
need to grow there.**



Perhaps the greatest question to ask here regarding soil health, grape vines and the grapes themselves is what are the basic requirements for life itself?

After all it is the life in the soil that determines true fertility.

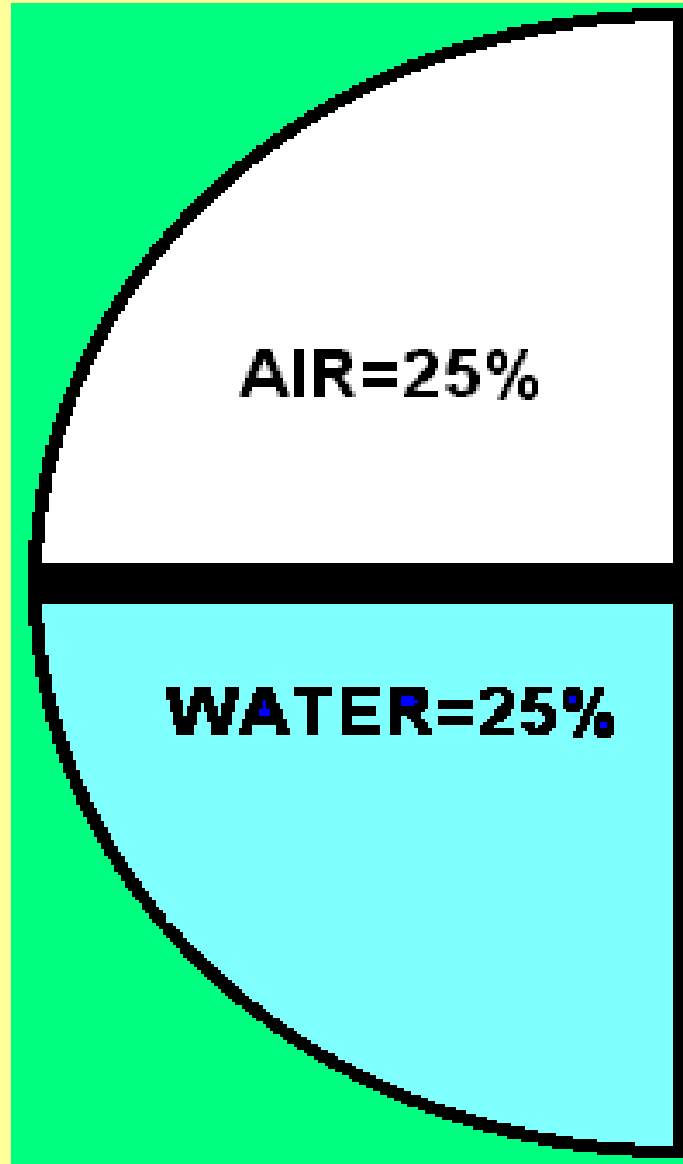


# Basic needs for life

- Shelter
- Food
- Water
- Air

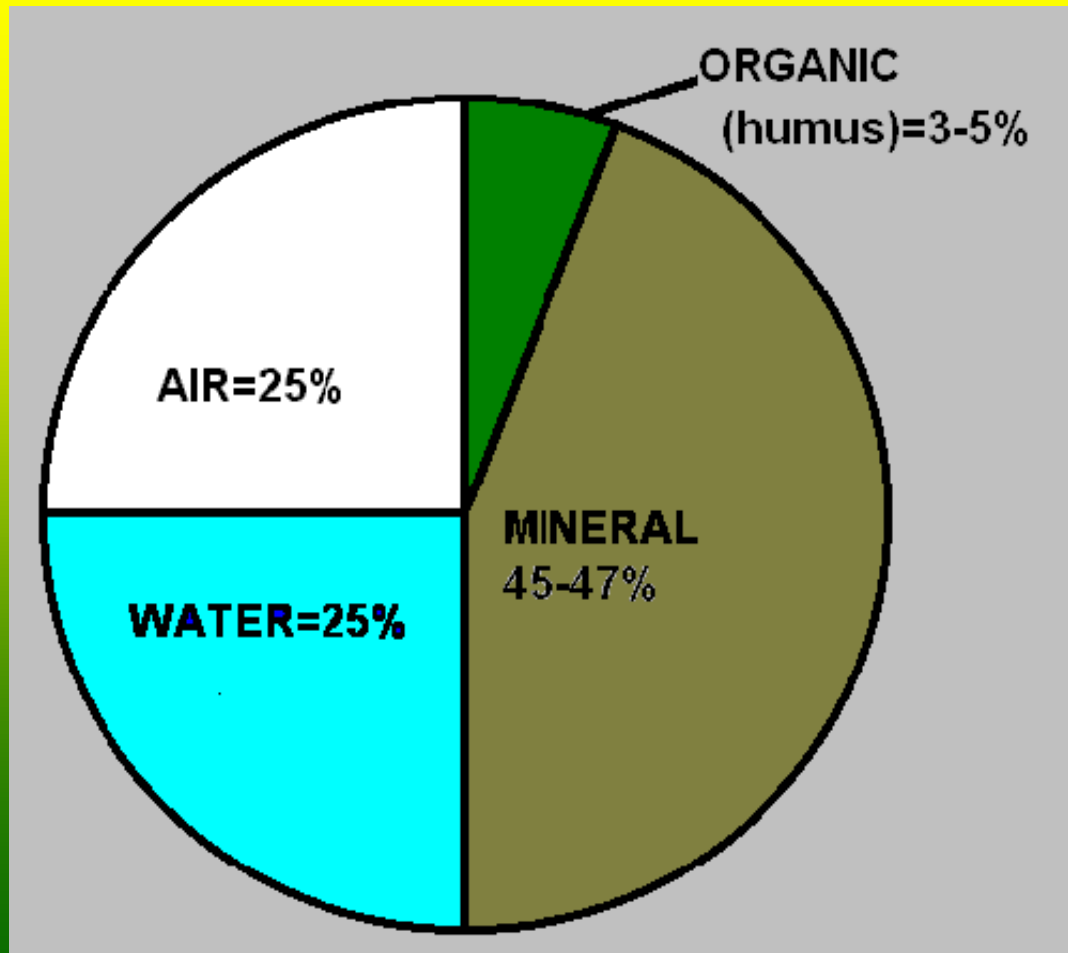
Which of these takes precedence in terms of immediate survival?





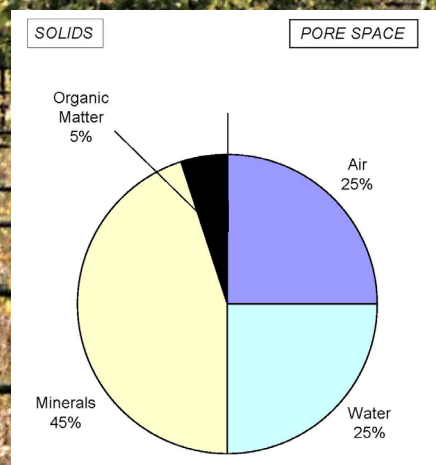


# The Ideal soil and its physical properties!





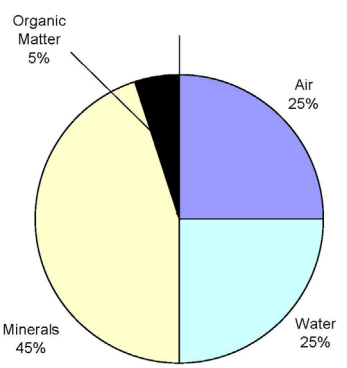
Soil text books teach that the physical structure of an ideal soil is made up of 50% solids and 50% pore space. Ideally, the solids part is comprised of 45% Minerals and 5% Organic Matter, while the pore space portion is comprised of 25% Air and 25% Water. However, those same text books do not tell what changes are needed in order to help soils that are lacking it achieve that correct physical structure.





SOLIDS

PORE SPACE



The physical structure of a soil can only be brought into alignment with the textbook definition of an ideal soil by a proper understanding and use of the Total Exchange Capacity & Base Saturation Percentages of that soil.

The percentage of Calcium, Magnesium, Potassium, and Sodium cations that occupy most of the sites on each colloid of the solids portion on the above diagram is what determines whether or not there is enough pore space to accommodate the correct air and water percentages needed for optimum plant growth. Of the four major cations that most influence the amount of pore space, Calcium and Magnesium are by far the most important and influential.

A soil that has a T.E.C. of 20 to 25 should have a Base Saturation of 68% Ca & 12% Mg in order to provide the correct amount of pore space. On the other hand a soil that has a T.E.C. of 5 should have a Base Saturation of 60% Ca & 20% Mg in order to have the ideal amount of pore space.



# ACHIEVING THE IDEAL PHYSICAL STRUCTURE FOR A SOIL

In order to bring the physical structure of a soil into alignment with the textbook definition of an ideal soil; first adjust the base saturation percentages of Ca, Mg, K, and Na to match the correct percentages needed for the total exchange capacity (TEC) of that particular soil. Doing this will help promote the proper nutrient uptake, the proper physical structure, and the ideal biological environment for that soil and crop. Since Calcium and Magnesium are by far the most important and influential of the four for achieving the proper soil structure, Always look at them first.

Before correcting the Ca & Mg there are three basic points that need to be understood:

- 1) The base saturation % of Calcium plus Magnesium always needs to equal 80 in order to achieve the ideal relationship between Ca & Mg as it affects the physical structure of the soil. (In other words, the proper relationship determines the friability of each soil -- whether it is too tight or too loose or works up as it properly should.) This relationship applies to every soil with a TEC of 4.16 or greater. (Lower TEC's must be covered separately in our Advanced Workshops specifically for very light sandy soils.)
- 2) The reaction of Ca & Mg to each other in terms of base saturation change is generally 1:1. This means that for every 1% increase in Ca the Mg will decrease by 1%, or for every 1% increase in Mg the Ca will decrease by 1%. (But watch higher TEC soils that may have free Magnesium trapped between the layers of clay and soils that have an abnormally high pH or percentage of K, or Na.)
- 3) Consequently, the first principle of nutrient balance involves correcting the obvious deficiencies in order to help control the excesses.



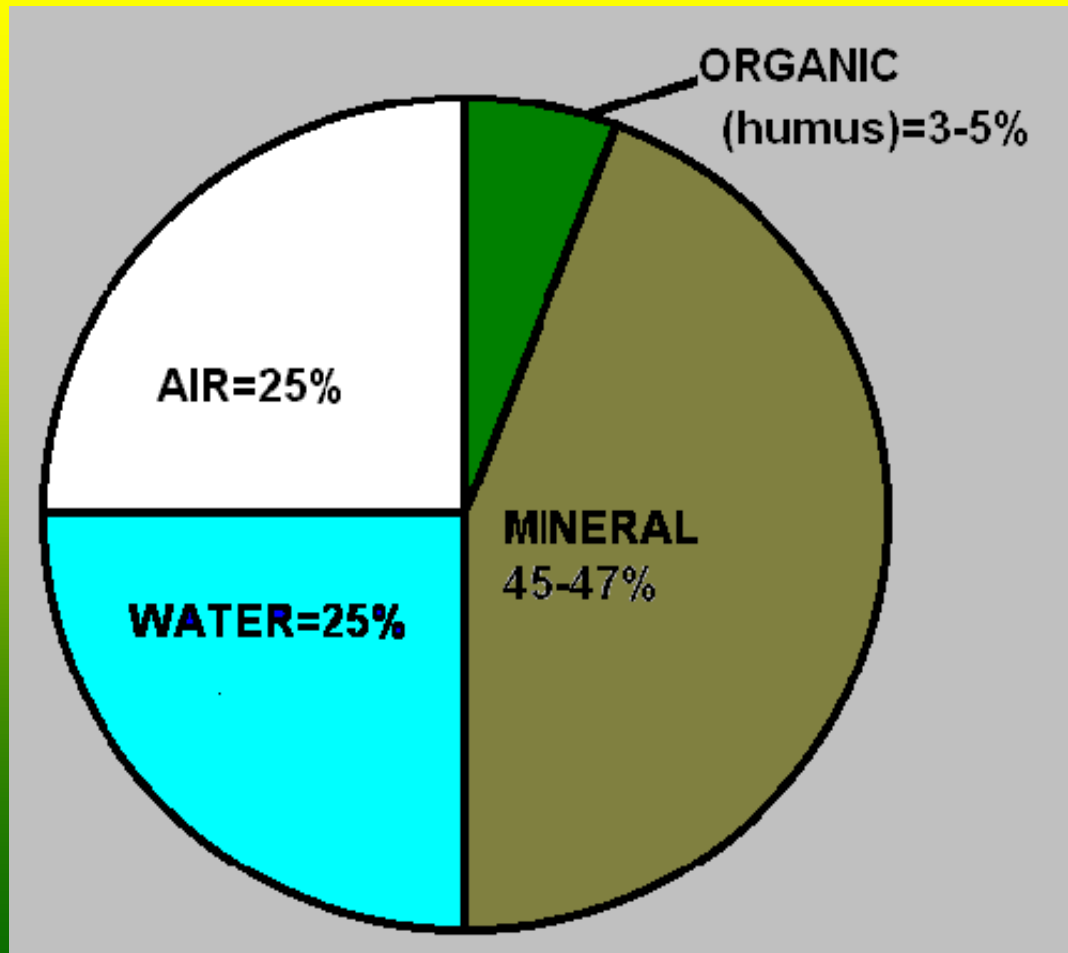
Every difference you can see in your soil  
or in your crop generally reflects a  
difference in soil fertility and soil health.





This is what is needed.

The Ideal soil and its physical properties!





# Optimum Percent Base (Cation) Saturation For Grape Vineyards

Cation

Percent Base

Saturation

Calcium

60-70

Magnesium

10-20

Potassium

2-5

Hydrogen

10-15

All Others

2-4



You can't properly manage what  
you don't correctly measure.  
**Test! Analyze! Treat!**





# The End

