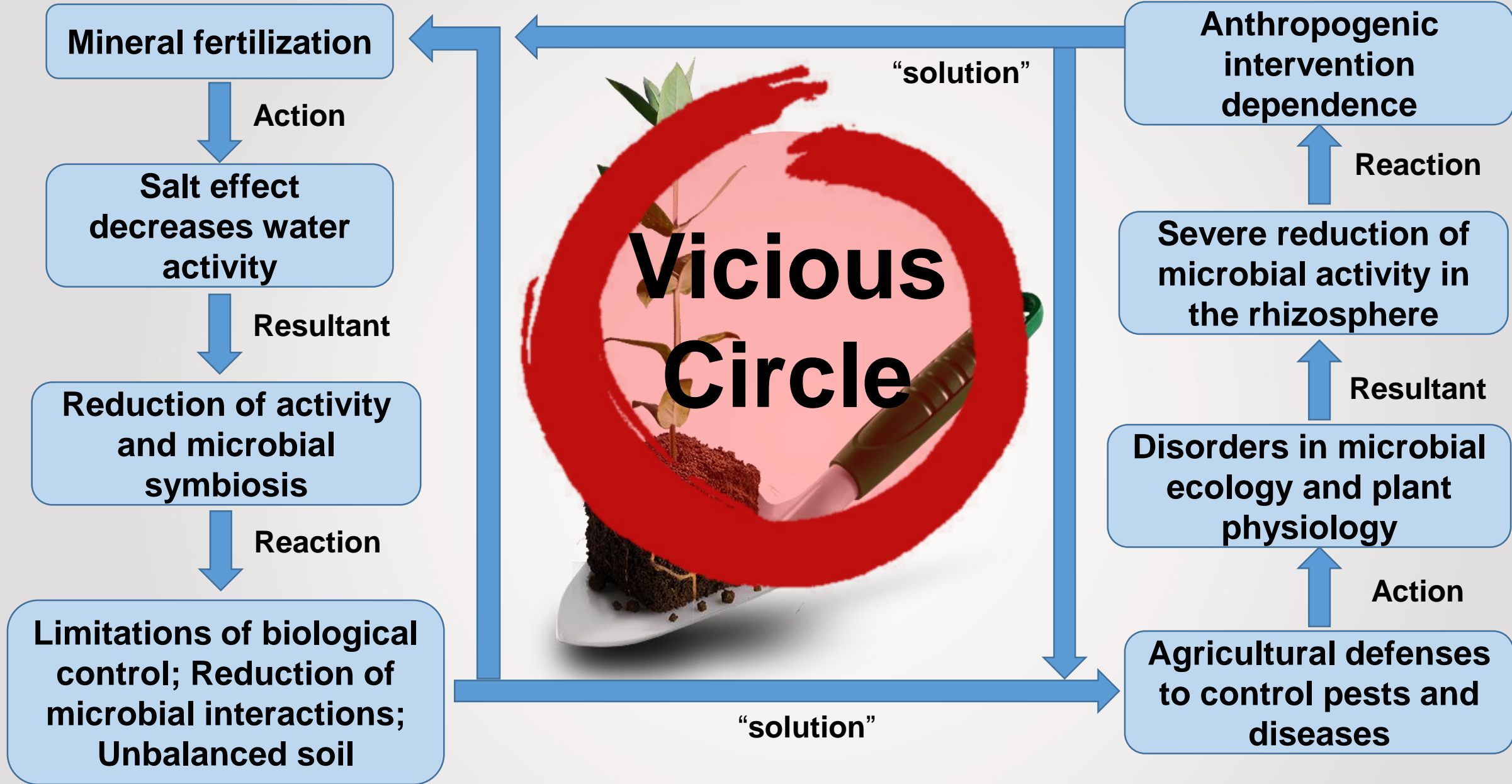
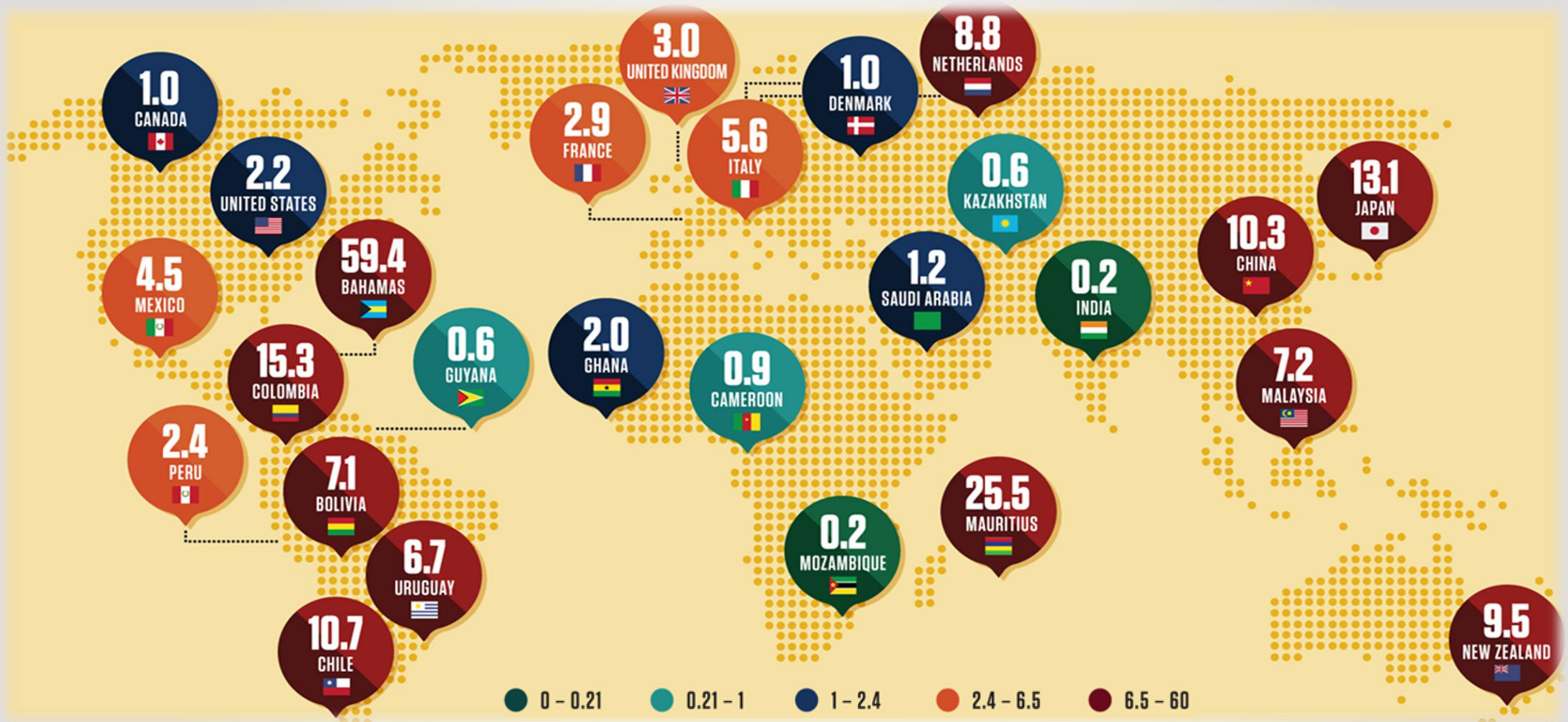


# How do we see the future agriculture?







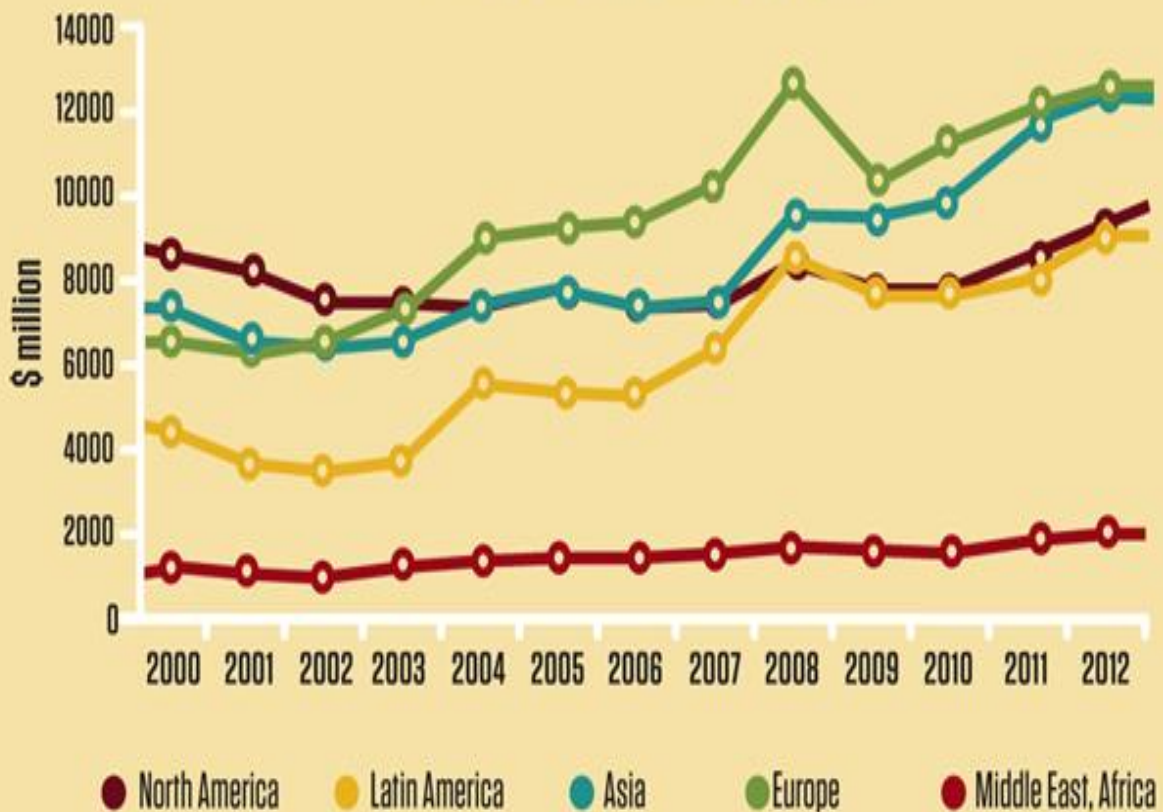
## Pesticides applied, Kg per ha of arable land, 2005-2012

SOURCE: AMERICAM ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

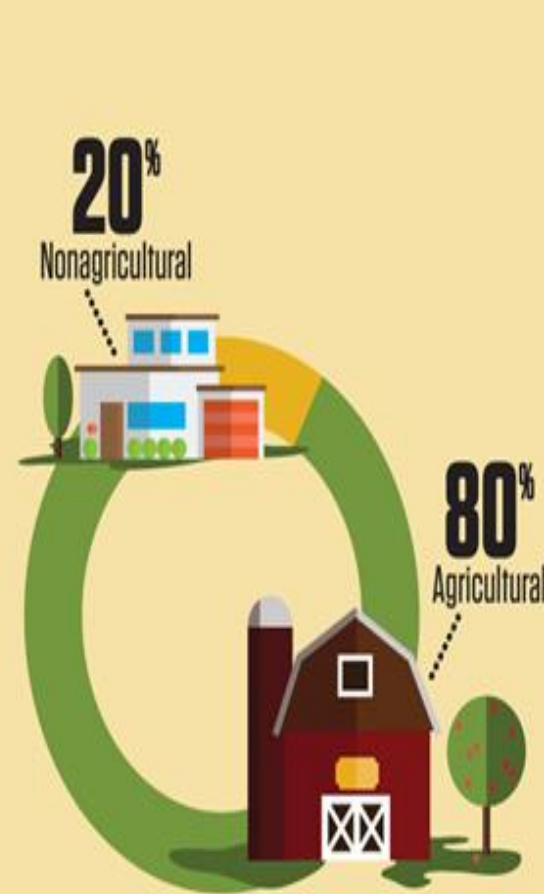


# MORE DEMAND, MANY USES

Global pesticide sales by region



Pesticide use by sector



Pesticide use by type, worldwide



SOURCE: AMERICAM ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





# UNINTENDED HARM

# 98

percent  
of **farm poisonings**  
go unreported in  
Central America



# 42

percent  
fewer species of invertebrates  
in streams with **severe**  
**pesticide contamination**



# 85

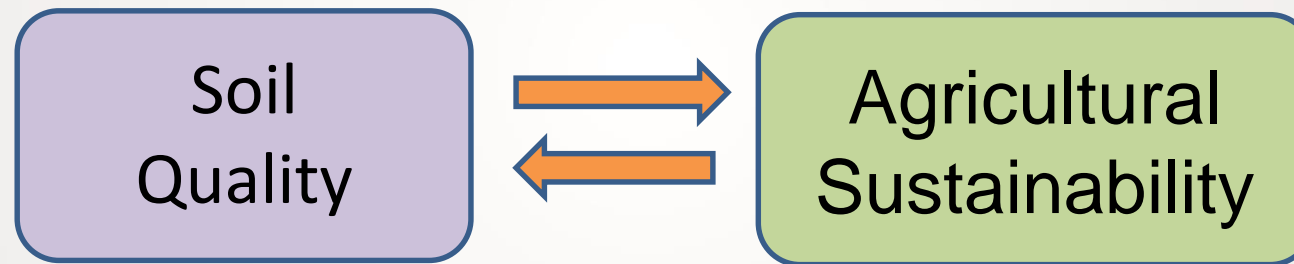
percent  
fewer new queens in  
bumblebee hives  
**exposed to insecticides**



# SOIL QUALITY

“SQ is the ability of the soil to perform its functions at the present moment and the preservation of these functions for future use”.

(USDA-NRCS, 2008)



NRCS = Natural Resources Conservation Service - US Department of Agriculture



# Soil Functions

Promote plant growth

Receive, store and supply water

Store, supply and nutrient cycling

Promote gas exchange

Promote biological activity

CHEMICAL

PHYSICAL

BIOLOGICAL

Indicators

- Content of N
- P MOS
- Organic P
- CTC
- pH

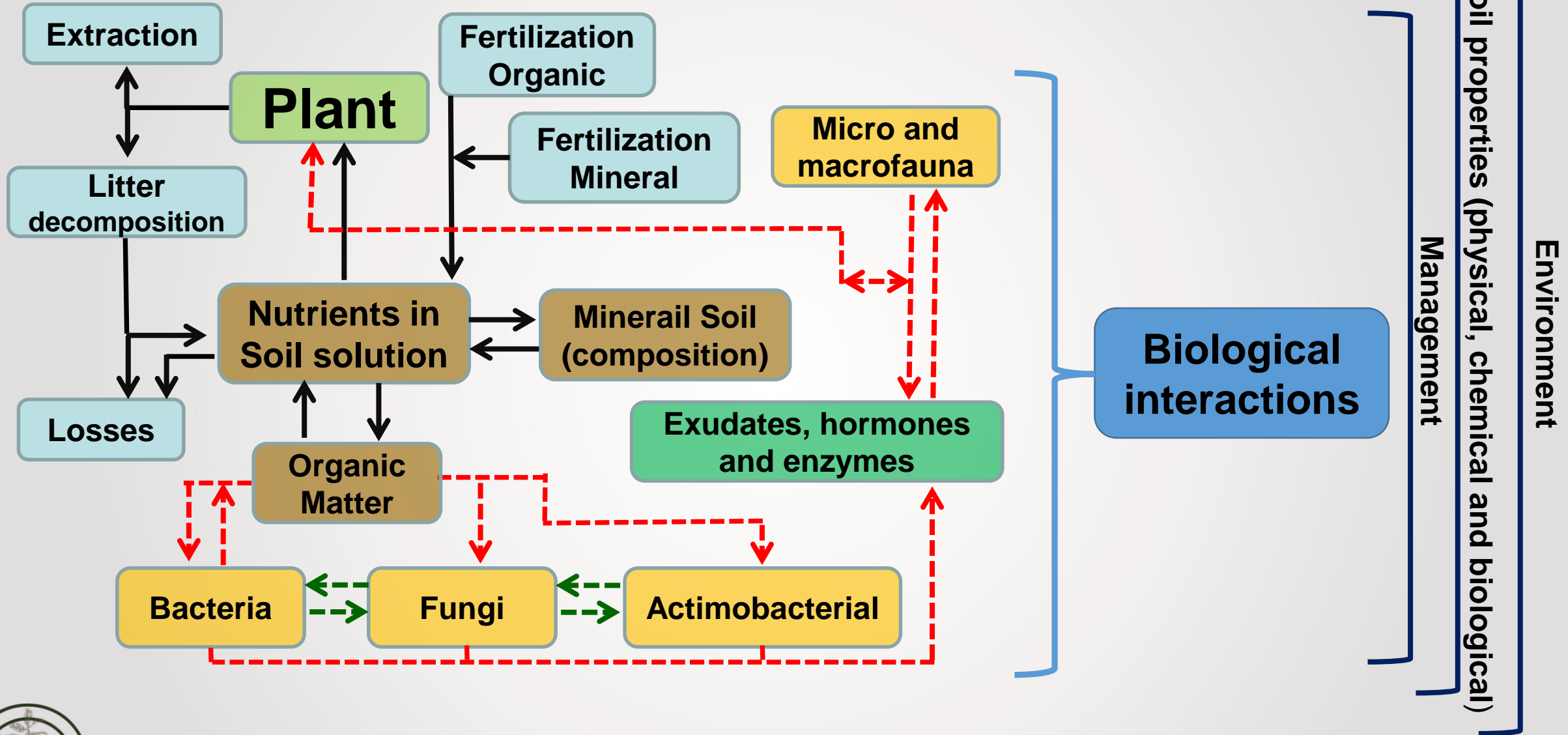
- Temperature
- Density
- Aggregation
- Water retention

- Biodiversity
- Activity of enzymes
- C and N in biomass
- Metabolic quotient
- Mineralization rate

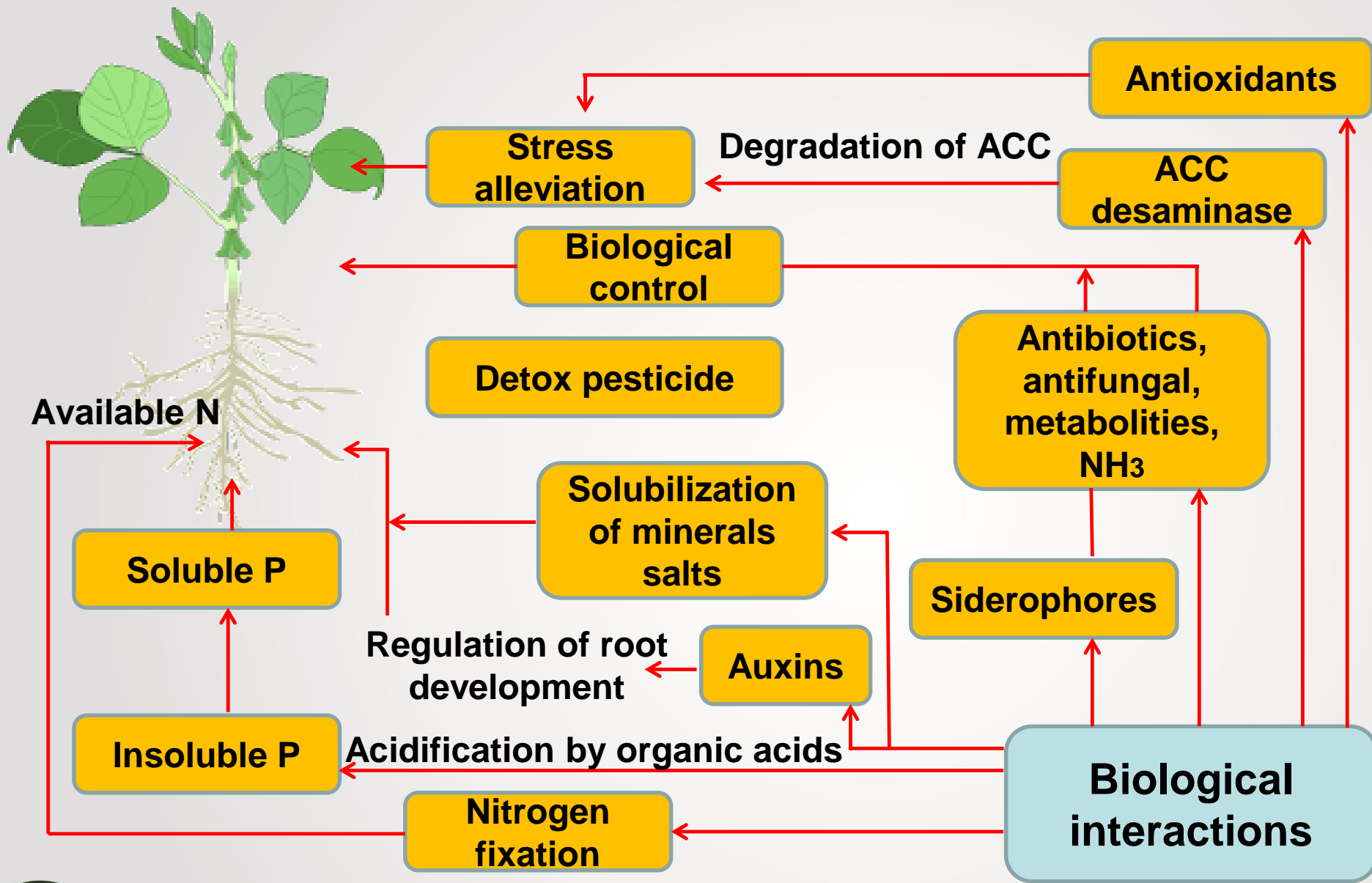
Soil quality attributes



# Nutrients dynamic in the soil

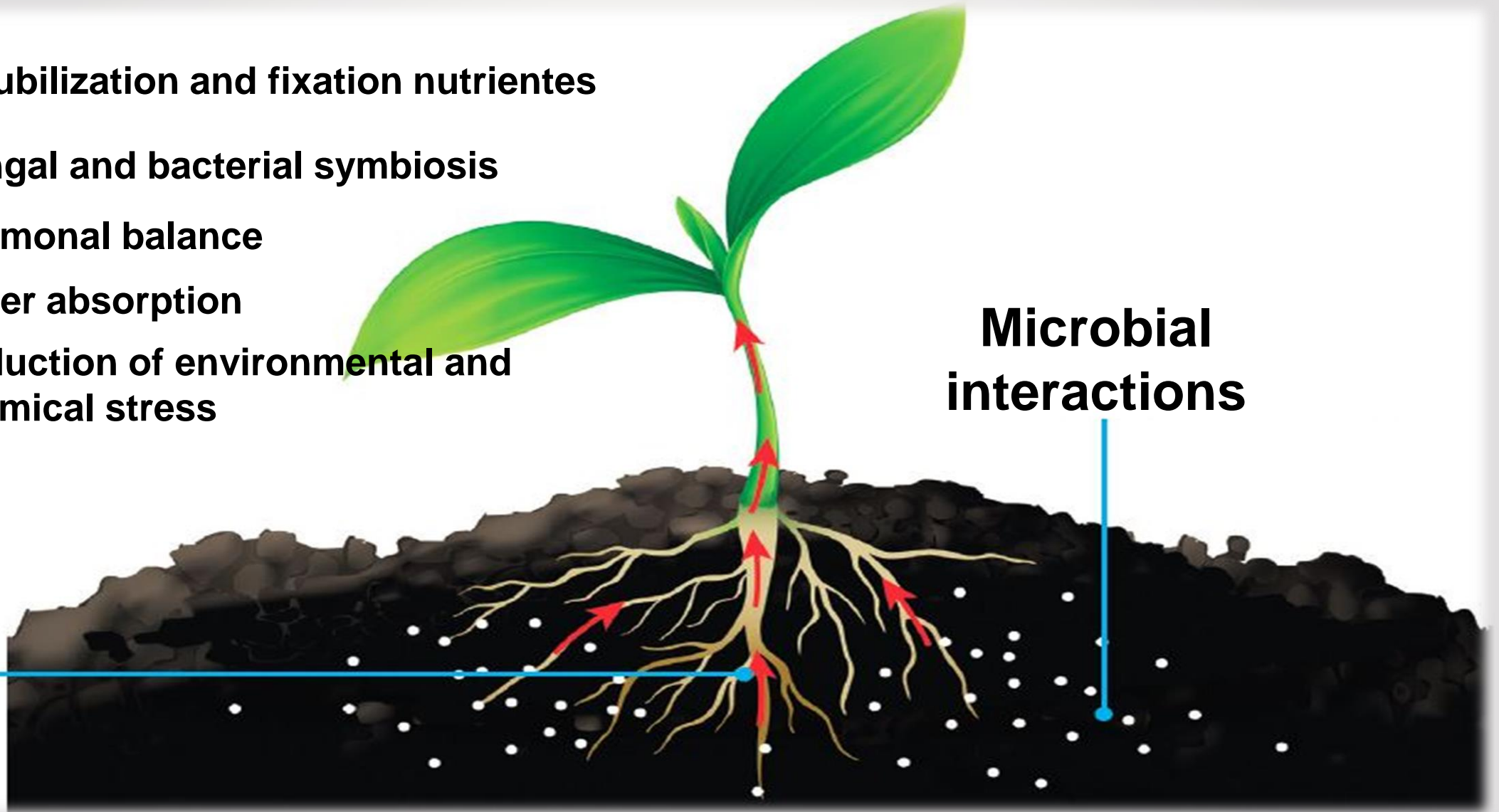






- Solubilization and fixation nutrientes
- Fungal and bacterial symbiosis
- Hormonal balance
- Water absorption
- Reduction of environmental and chemical stress

## Microbial interactions



# Ways for a clean agriculture... Biological interactions for food production

**Hormonal balance**

**Increase of carbohydrates available**

**Reducing the severity of diseases**

**Optimization of water use**

**Plant-plant interactions**

**Efficient absorption of nutrients**

**Increase in microorganism symbiosis**

**Optimizing the use of nitrogen**

**Induction of root growth**



## Biological Fertility

Feed the soil  
and the plant

ORGANIC MATTER

MICRO-ORGANISMS

SOIL NUTRIENTS

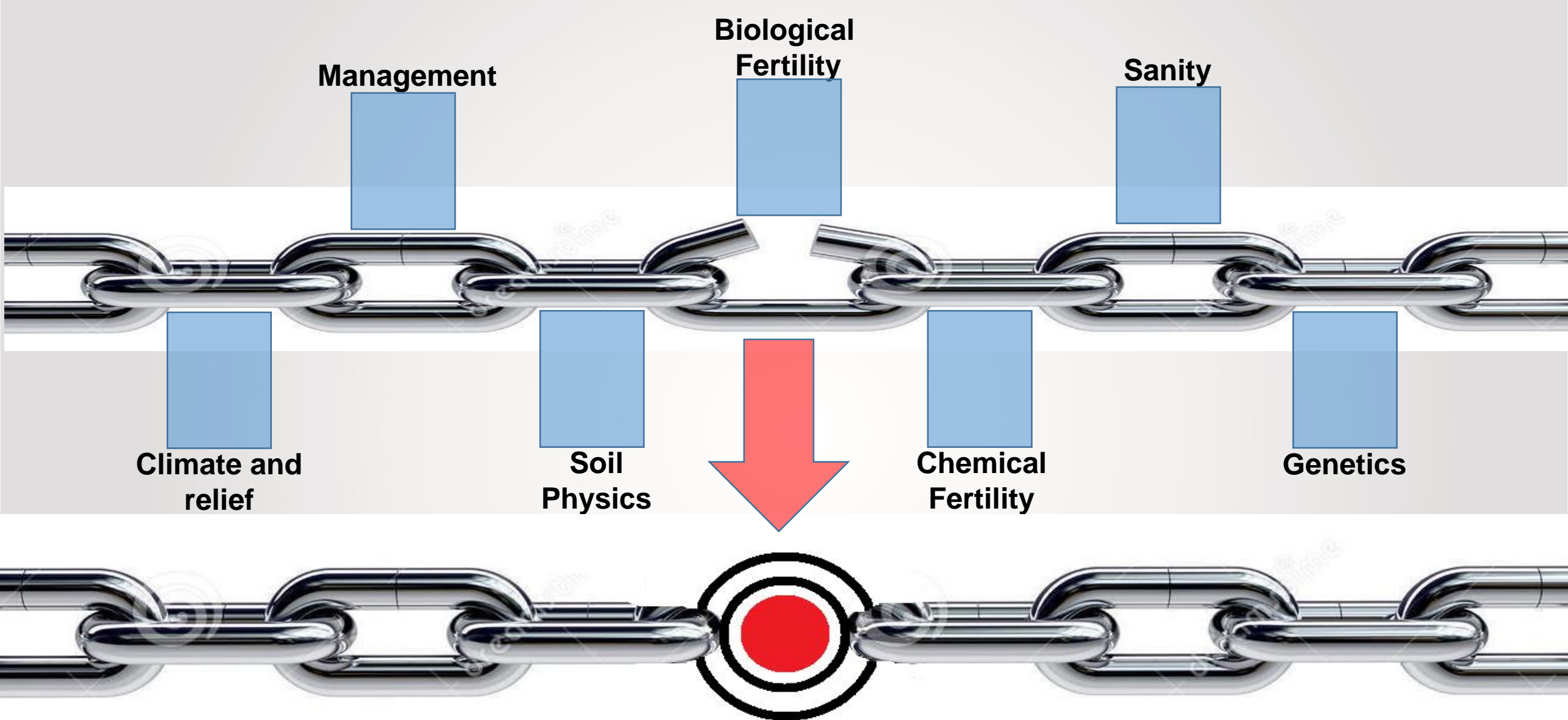
PLANT NUTRIENTS

## Chemical Fertility

Feed only the plant  
and damage the soil

PLANT NUTRIENTS





A diagram illustrating the relationship between plant growth, ecosystem balance, and microbial interactions. It features a central green plant with two upward-pointing arrows. The background is divided into a light blue sky, a dark brown soil layer, and a white ground layer. Various colorful microbes, including pink worms, blue and orange bacteria, and green fungi, are shown in the soil. Three text boxes are overlaid on the diagram: 'Sustainable Production' at the top, 'Balanced Ecosystems' in the middle, and 'Microbial Interactions' at the bottom.

Sustainable Production

Balanced Ecosystems

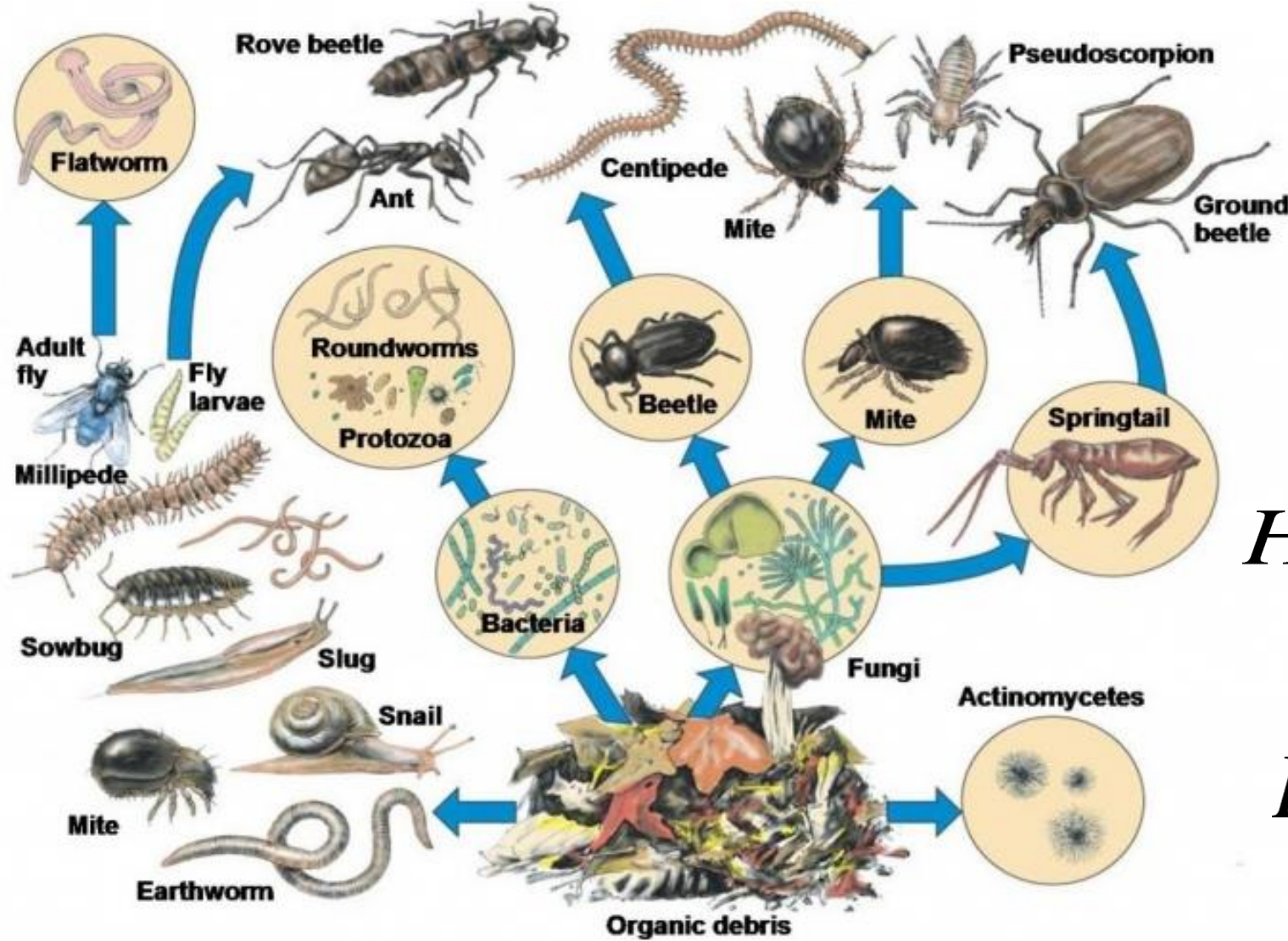
Microbial Interactions



What is the difference between soil and dirt



# Food network in soil

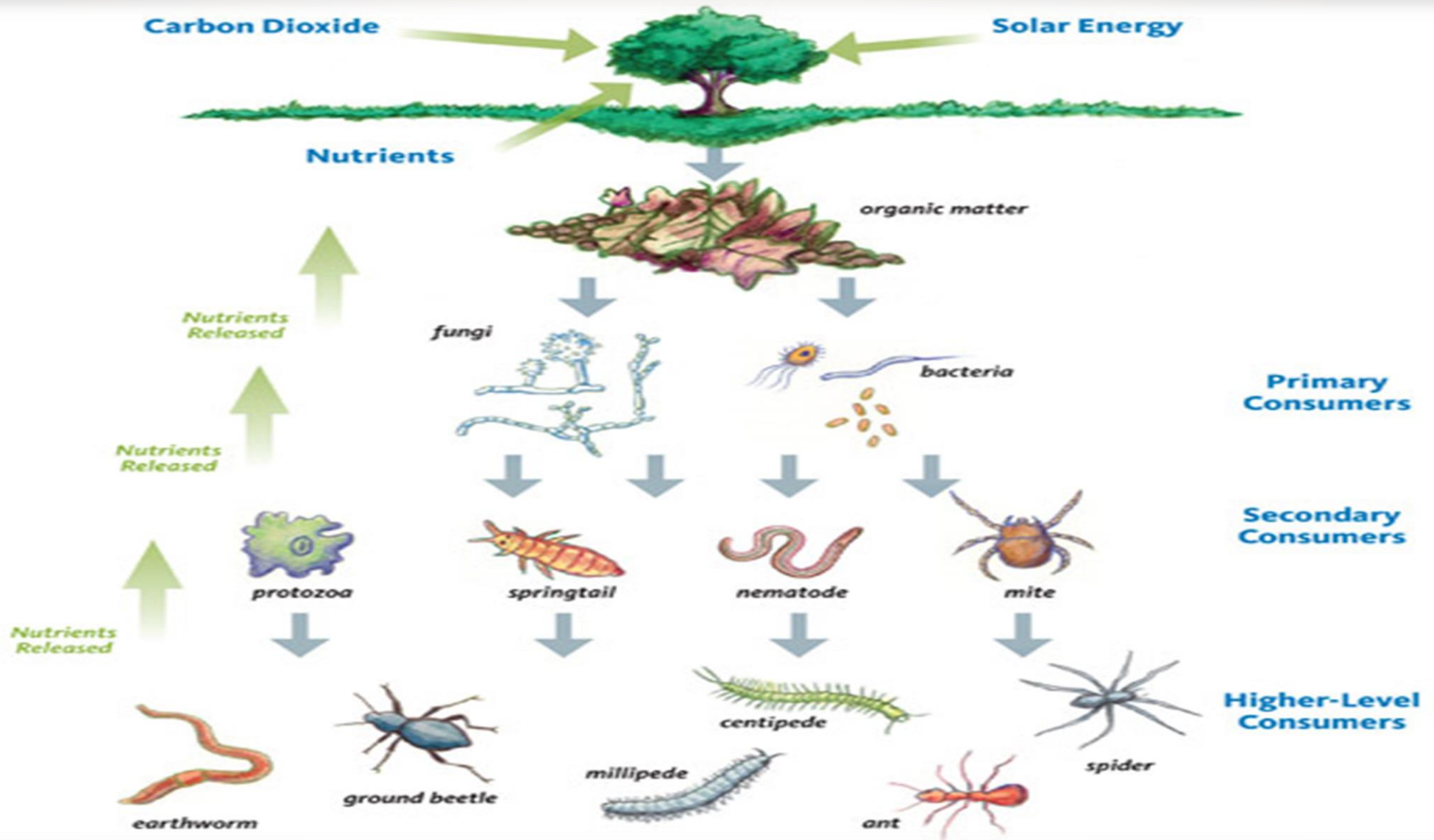


$$H' = - \sum_{i=1}^S p_i \ln p_i$$

$$D = \sum_{i=1}^S \frac{n_i(n_i - 1)}{N(N - 1)}$$







# How to activate biological systems?



# Some published works

**Effect of Microwave Electromagnetic Radiofrequency on Germination and Seedling Growth Consequences of Six Wheat *Triticum aestivum* L. Cultivars**

**Abdelghafar M. Abu-Elsaoud**

*Department of Botany, Faculty of Science, Suez Canal University, Ismailia 41522, Egypt*

**Einfluss schwacher elektromagnetischer Felder (konstant, wechselnd bzw. durch Zyklotron erzeugt) auf die Fibroblastenproliferation in vitro**

**Gennadi Afinogenov<sup>1</sup>**

**Anna Afinogenova<sup>1</sup>**

**Andrey Kalinin<sup>1</sup>**

<sup>1</sup> Research Institute of  
Traumatology n.a. R.R.  
Vreden, St. Petersburg,  
Russia

**Influence of stationary magnetic field on lentil seeds** ARTICLE *in* INTERNATIONAL AGROPHYSICS · JANUARY 2010 [ResearchGate](#)

**Effect of Magnetic Field on Seed Germination and Early Growth of *Calendula officinalis* L.**

**Hosein Salehi Arjmand and Saeed Sharafi\***  
Arak University, Agriculture Faculty, Iran-Arak

Journal of Ornamental Plants  
Available online on: [www.jornamental.com](http://www.jornamental.com)  
ISSN (Print): 2251-6433 ISSN (Online): 2251-6441



# Some published works

World Academy of Science, Engineering and Technology

International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering Vol:4, No:8, 2010

## Effect of Magnetic Field on Seed Germination of Two Wheat Cultivars

Ahmad Gholami<sup>1</sup>, Saeed Sharafi<sup>2</sup> and Hamid Abbasdokht<sup>1</sup>

International Journal of  
**Molecular Sciences**

### Electromagnetic Biostimulation of Living Cultures for Biotechnology, Biofuel and Bioenergy Applications

Ryan W. Hunt<sup>1,\*</sup>, Andrey Zavalin<sup>2</sup>, Ashish Bhatnagar<sup>1</sup>, Senthil Chinnasamy<sup>1</sup> and  
Keshav C. Das<sup>1</sup>

### Features of Usage of Electromagnetic Field of Extremely Low Frequency for the Storage of Agricultural Products

Kasyanov Gennady Ivanovich<sup>1</sup>, Syazin Ivan Evgenyevich<sup>1</sup>, Grachev Alexandr Vasilyevich<sup>1</sup>,  
Davidenko Taisiya Nikolaevna<sup>2</sup>, Vazhenin Evgeniy Igorevich<sup>1</sup>

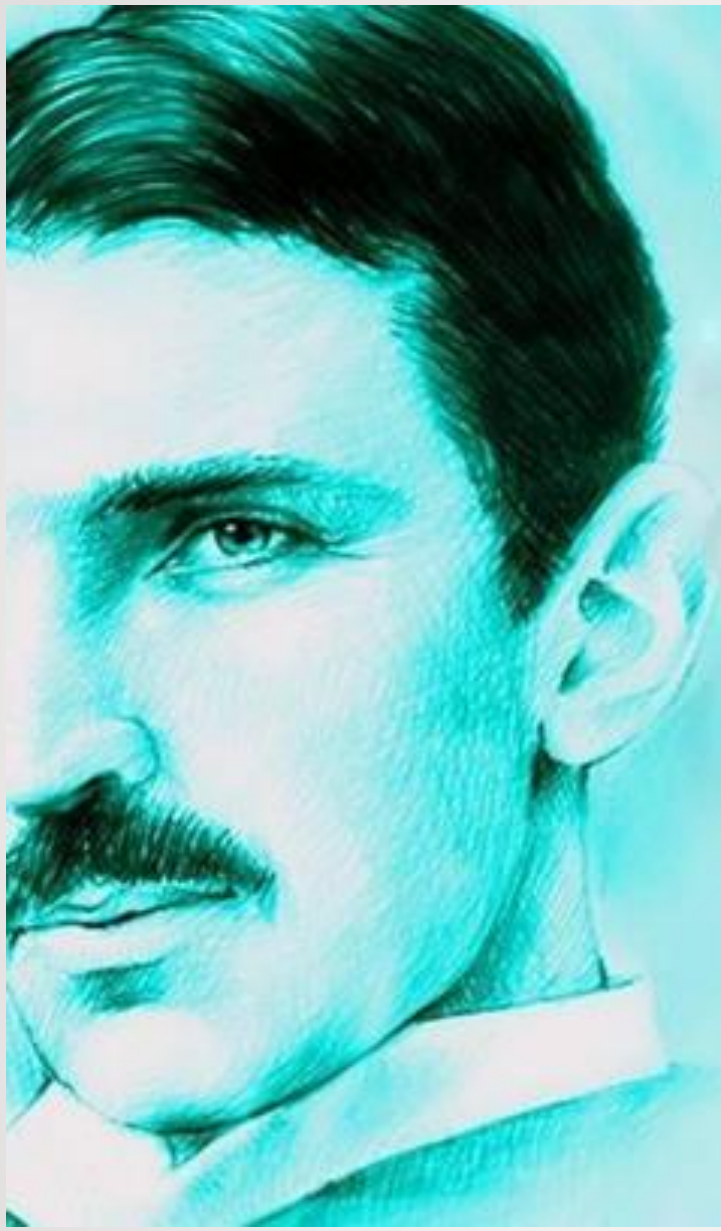


Journal of Applied Biosciences 22: 1350 - 1358

### The influence of AC electromagnetic fields on the initial radicle growth rate of *Phaseolus vulgaris* L.

Odhiambo O. Jared<sup>1\*</sup>, Ndiritu G. Francis<sup>1</sup> and Wagara N. Isabel<sup>2</sup>





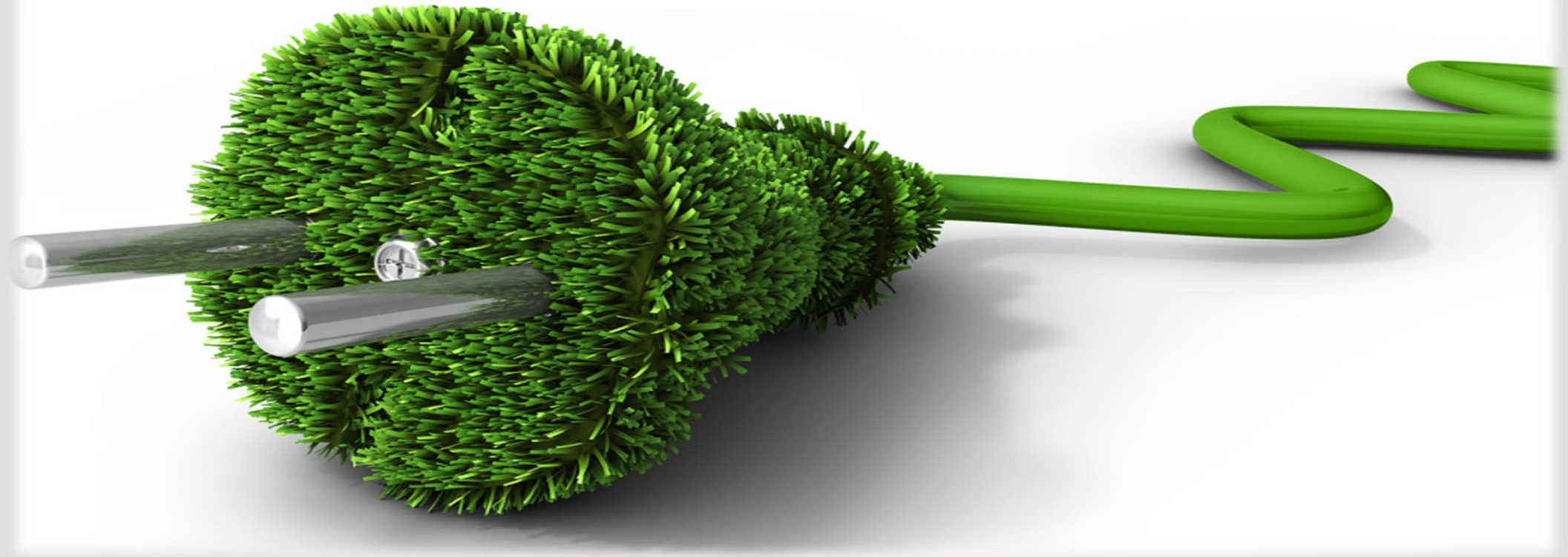
“If you want to find  
the secrets of the  
universe, think in  
terms of energy,  
frequency and  
vibration...”

Nikola Tesla



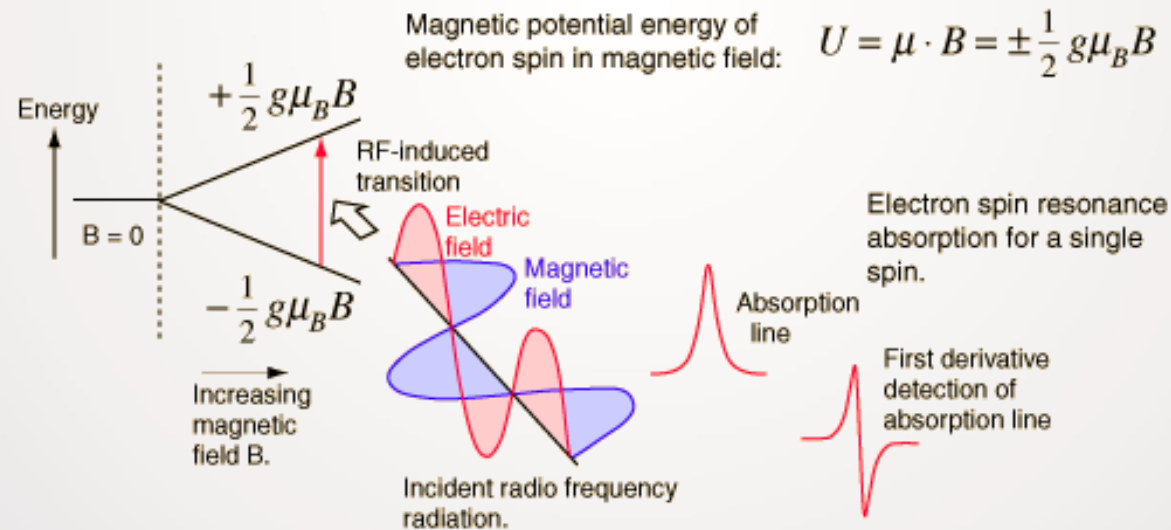
The difference of PENERGETIC technology is on the energizing process, obtained through electro magnet waves in reduced spectrum. Such reduced energetic charge, not harmful to any live organism, acts towards the biological activity, naturally observed, in the systems soil/plant, plant/atmosphere and/or soil/micro-organisms.

**This process is denominated bio activation.** On this way, the term bio activation does not mean that the PENERGETIC products have biological actives but that the use of technology results on the activation or stimulation of life in nature, on soil as well as on plants.

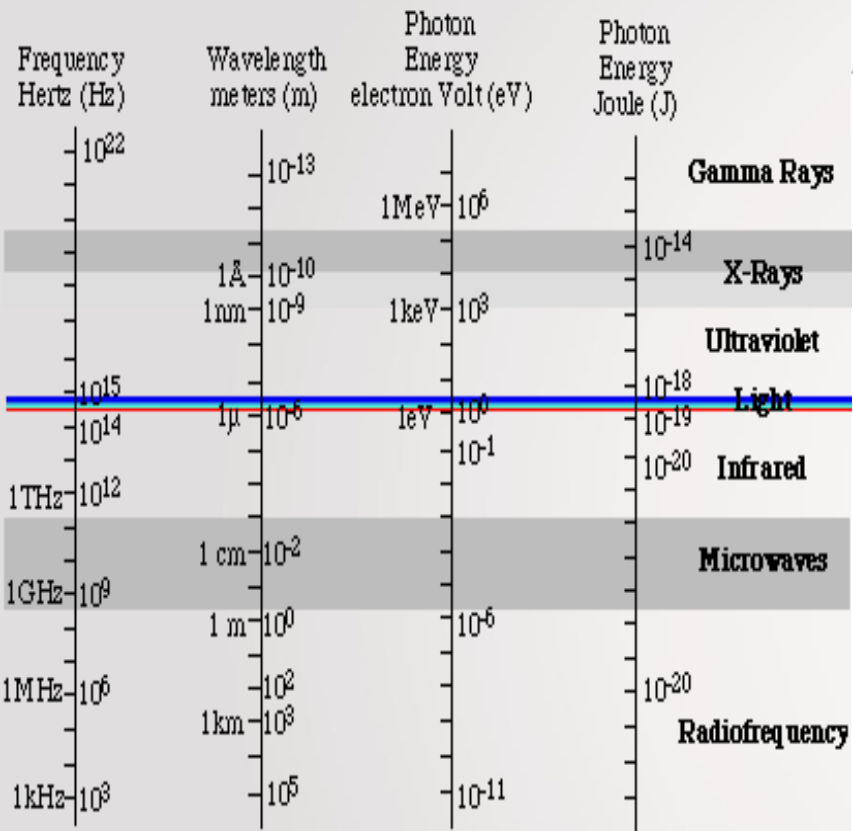


# What is the penergetic<sup>®</sup> Technology?

It is a soil and plant bio-activation tool that contributes to the improvement of the chemical, physical and biological properties of the soil, directly reflecting in the quality and productivity of the agricultural crops.



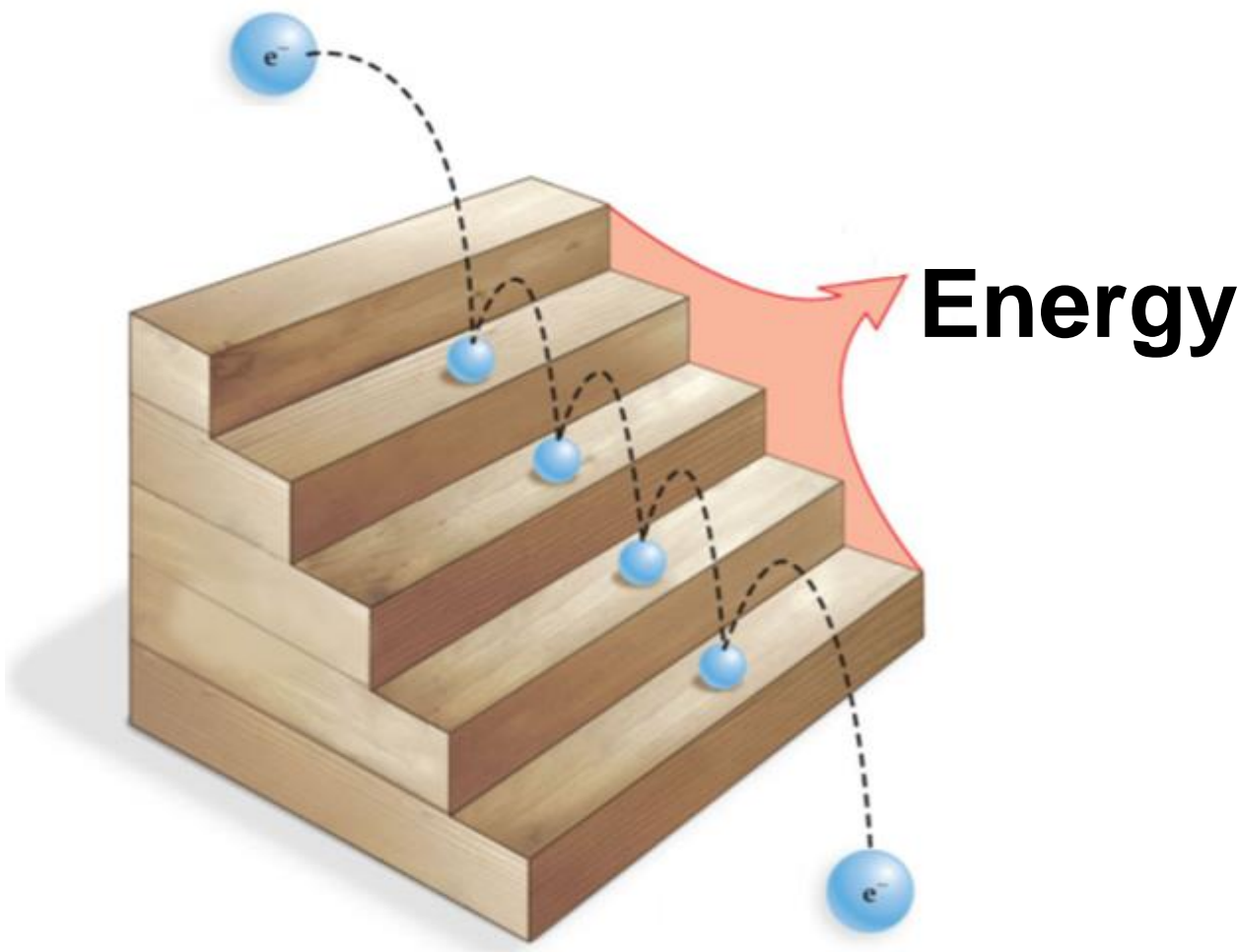
# The Electromagnetic Spectrum



Unit Abbreviations:

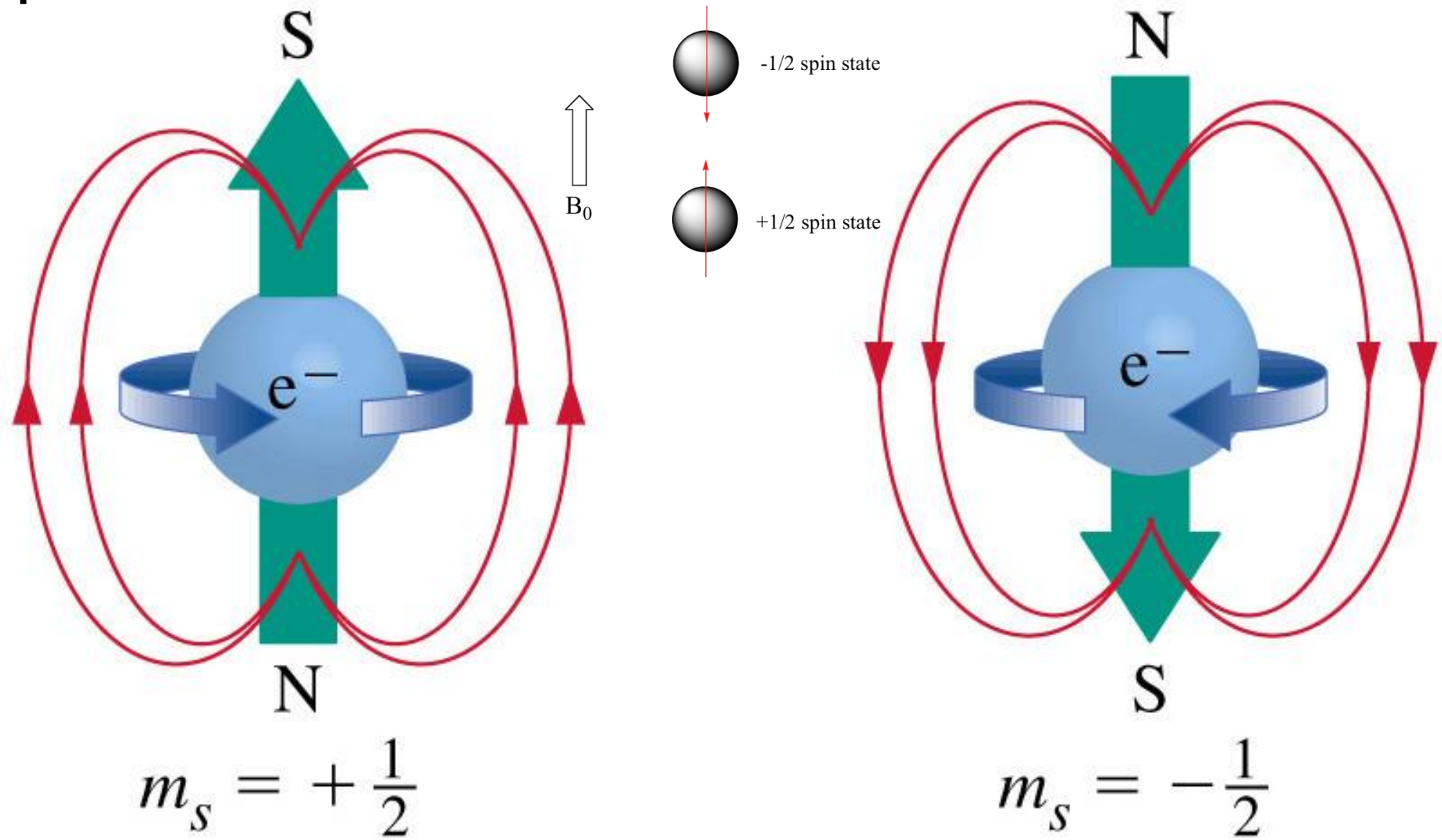
THz terahertz	Å Angstrom	MeV Mega (or Million) electron Volts
GHz gigahertz	nm nanometer	keV kilo-electron Volts
MHz megahertz	μ micron	
kHz kilohertz	cm centimeter	
	km kilometer	

$$\sum_{i=1}^m w_P^{IC} = f(w_{Pi}^{OS}, E, H_{1,2}, \emptyset_{1,2}, t_E, t_{H_{1,2}}, OS_{A,d}^n, \overline{OS^{nIC^0}}, \int_{H_{1,2}}, \int_{H_{1,2}}^{Profil})$$





# Spin rotation: Mechanics of life



# Electro - Magnetic waveforms



In 1887, Heinrich Hertz demonstrated the reality of Maxwell's electromagnetic waves by experimentally generating radio waves in his laboratory

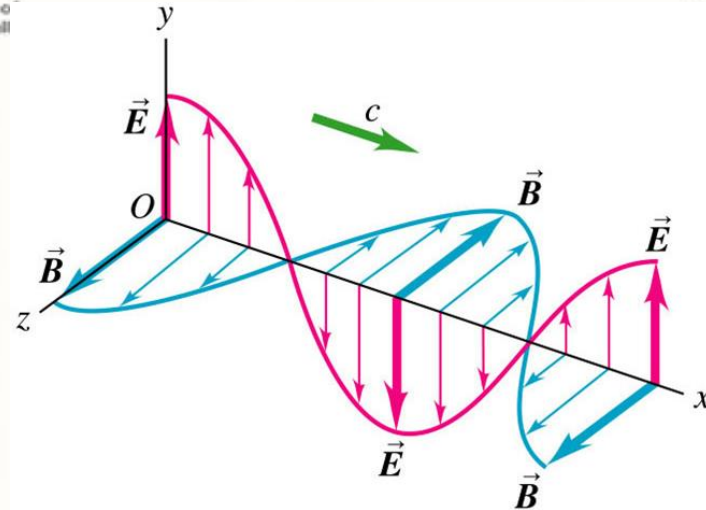
Heinrich Hertz



(22 February 1857 - January 1 1894)

*f*

Cycles per Second



Through longitudinal waves, Tesla transferred energy to receiving devices. He sent electrostatic forces through the air, transferred electrical energies and noted the lethal forces produced by these waves

Nikola Tesla



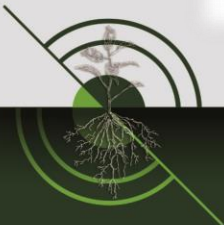
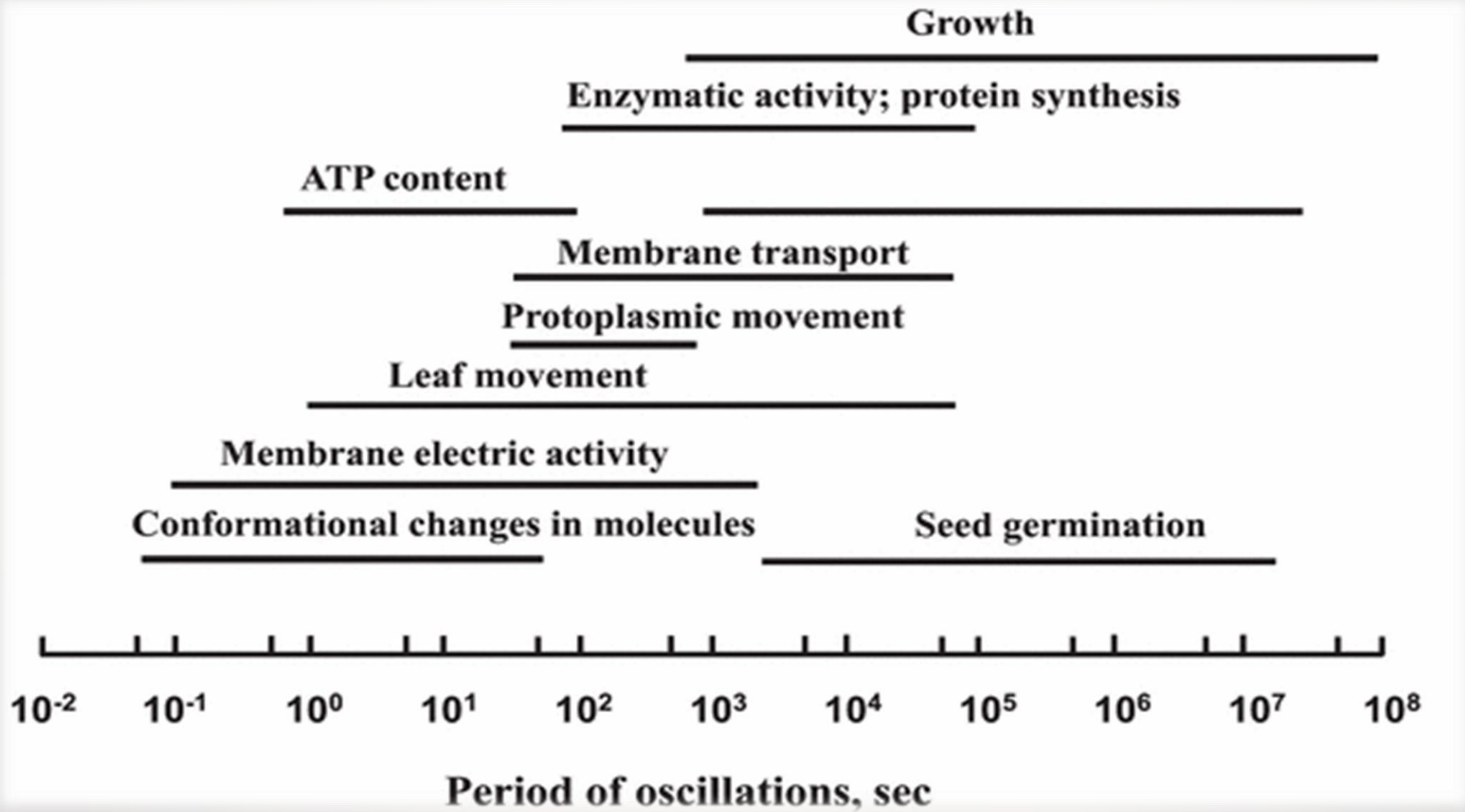
(10 July 1856 - 7 January 1943)

*V*

Volts per Second



# Frequency: effects on biological processes



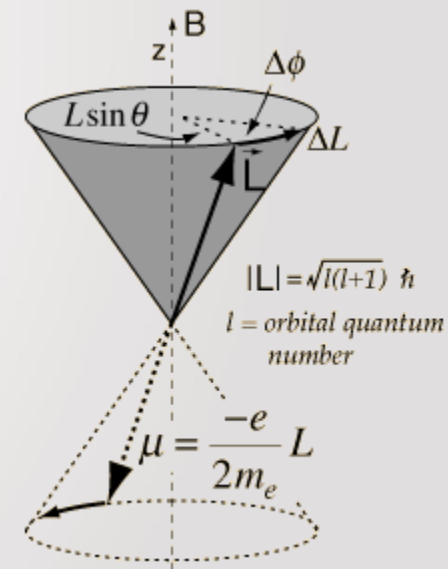
For example:

$$\omega_{electron\ spin} = \frac{2\mu_e B}{\hbar} = \frac{2 \cdot 2 \cdot \frac{1}{2} (5.79 \times 10^{-5} \text{ eV / T})(1\text{T})}{6.58 \times 10^{-16} \text{ eV} \cdot \text{s}} = 1.7608 \times 10^{11} \text{ s}^{-1}$$

$$\nu = \frac{\omega}{2\pi} = 28.025 \text{ GHz} \quad \text{Larmor frequency}$$


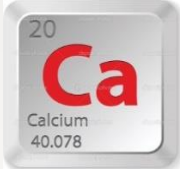

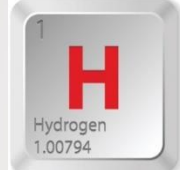
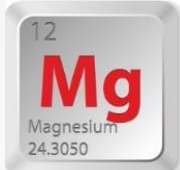


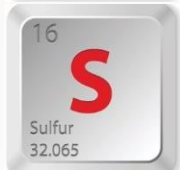







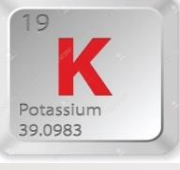


$$\omega_{proton\ spin} = \frac{2\mu_p B}{\hbar} = \frac{2(2.79)(3.15 \times 10^{-8} \text{ eV / T})(1\text{T})}{6.58 \times 10^{-16} \text{ eV} \cdot \text{s}} = 2.6753 \times 10^8 \text{ s}^{-1}$$

$$\nu = \frac{\omega}{2\pi} = 42.5781 \text{ MHz} \quad \text{Larmor frequency}$$



# Curiosity: What is the frequency of the constituent elements of a plant?

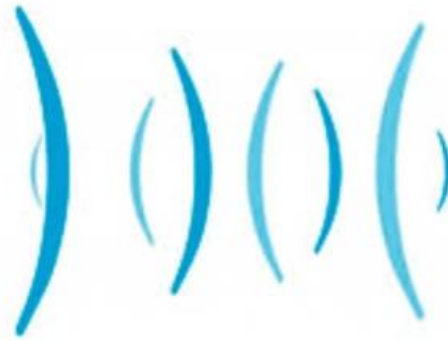


	75,43 MHz*		20,18 MHz		26,80 MHz
	300,00 MHz		18,35 MHz		79,51 MHz
	40,67 MHz		23,00 MHz		18,76 MHz
	21,67 MHz		70,84 MHz		32,23 MHz
	121,44 MHz		19,54 MHz		73,99 MHz
	13,99 MHz		29,39 MHz		9,69 MHz

\*Using a magnetic field of 7.04T



**Tuning fork  
A**

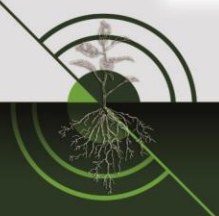


**Tuning fork  
B**

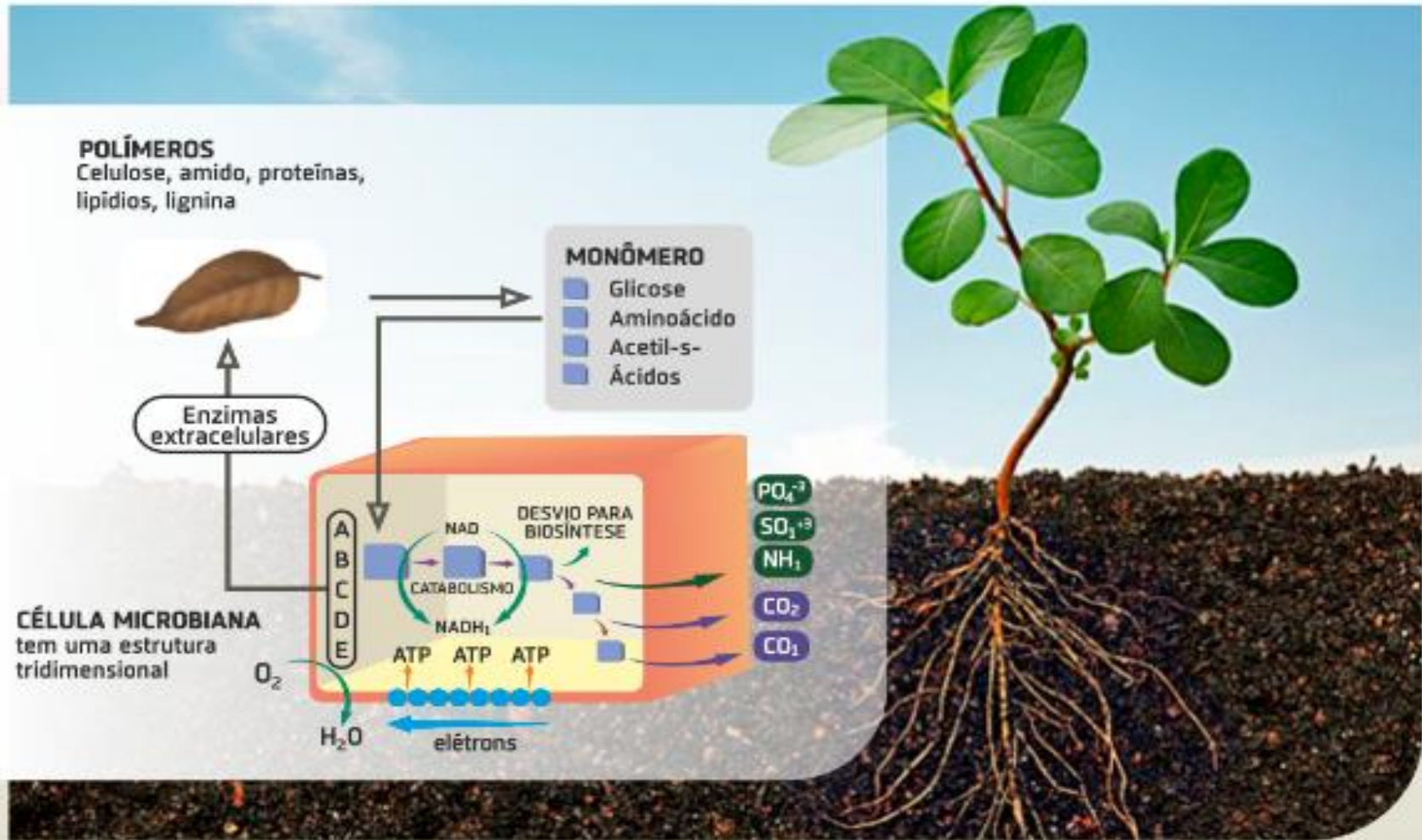
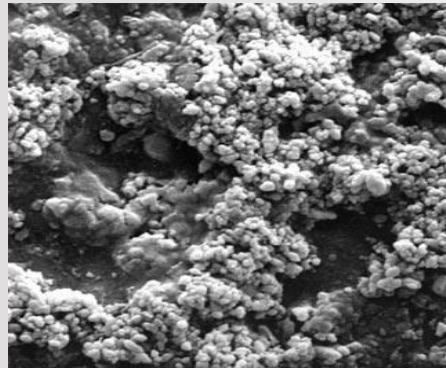
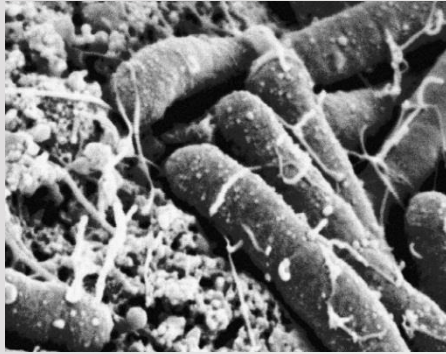




microbes







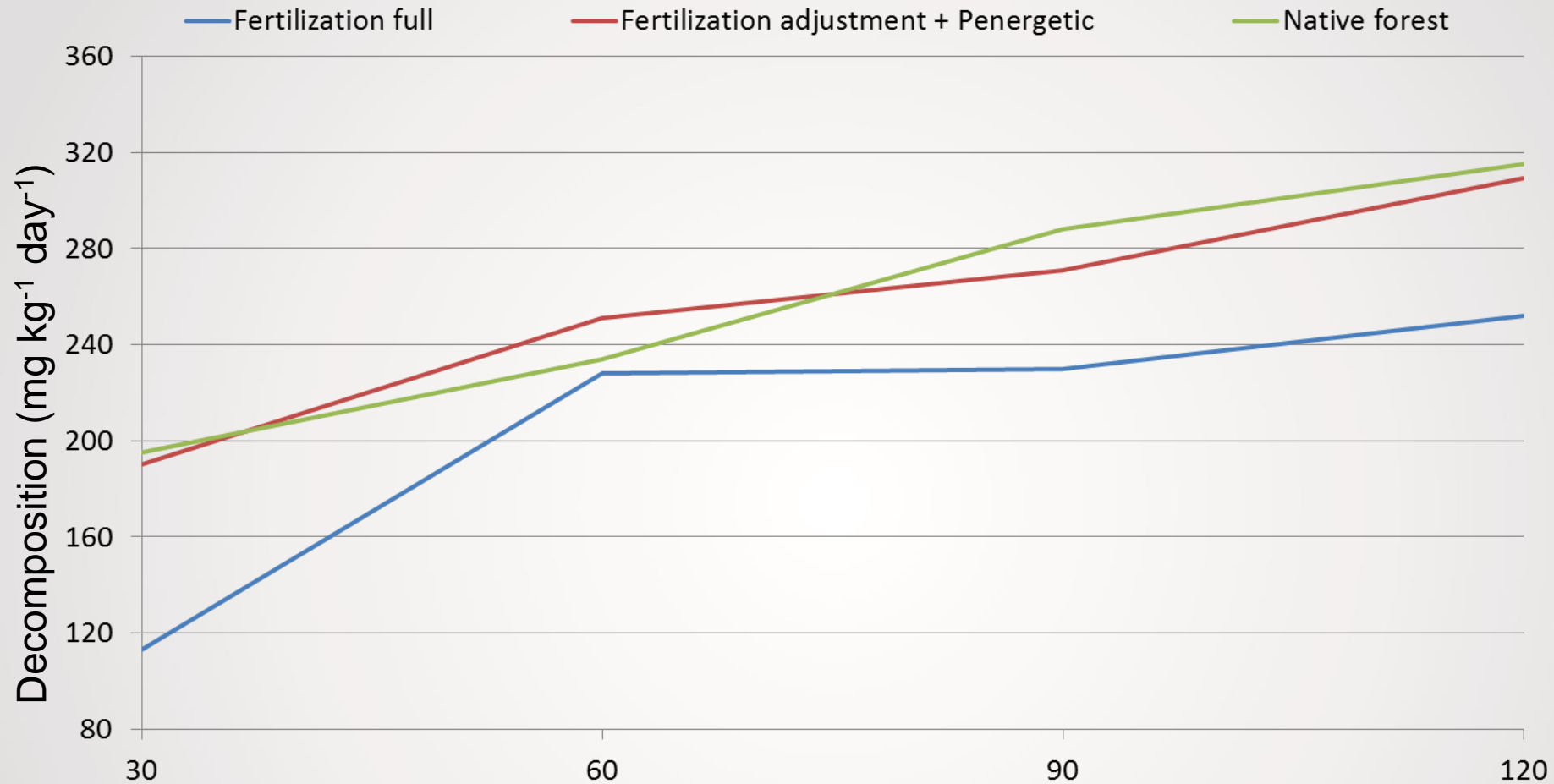
# Experiments with Penergetic



**A****C****B**

Corresponding decomposition bags experimental units (A). Random distribution of experimental units on the ground surface (B). Detail of the decomposition bags partially covered by soybean leaves (C) (Steffen et al., 2016).





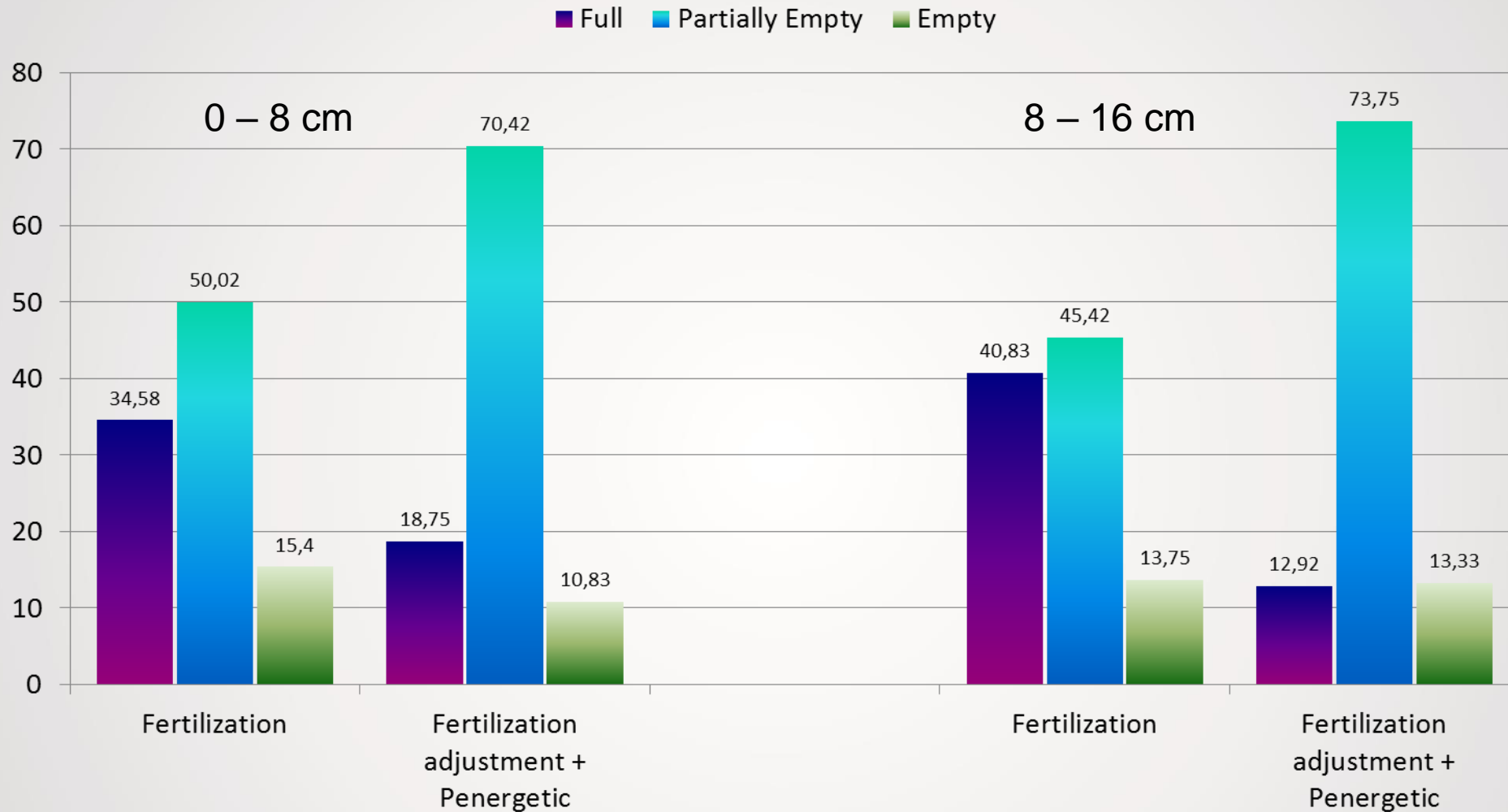
Coefficient of decomposition of the mulch of crop residues 30, 60, 90 and 120 days after emergence of wheat, using the methodology of decomposition bags (litter bags). Average of five replicates (Dra. Gerusa Steffen et al.).





Bait lamina to determine the microbial activity in the soil (Dra. Gerusa Steffen et al.).

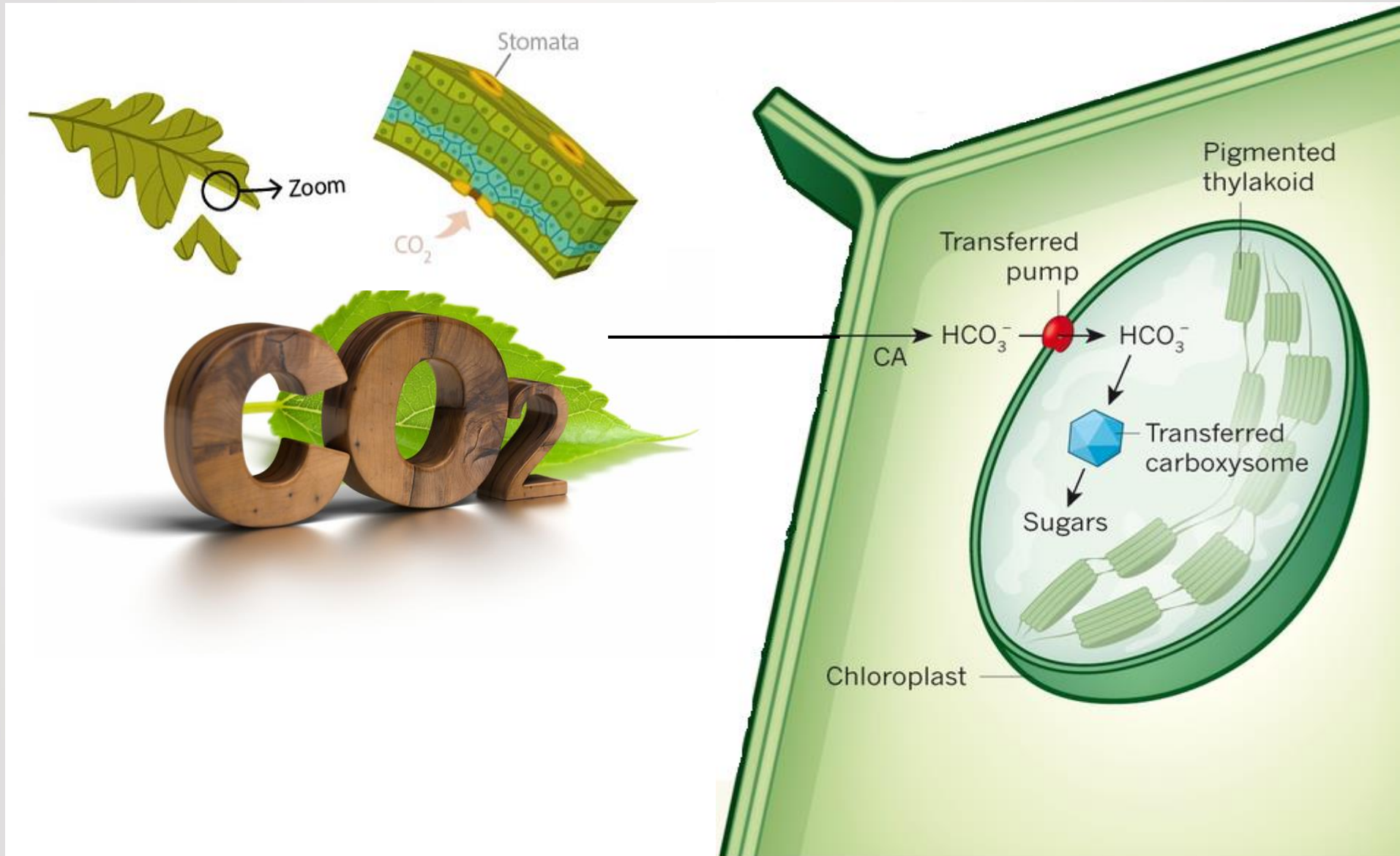




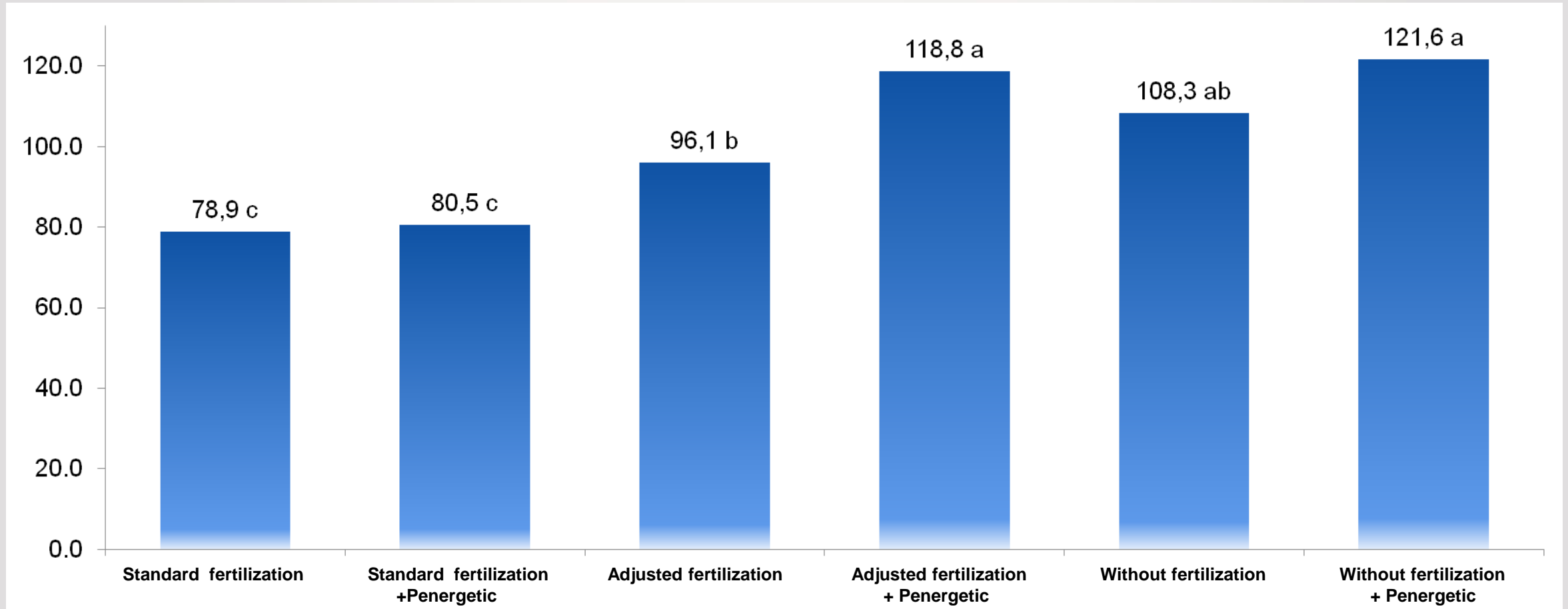
Feeding activity of soil organisms to 8 and 16 centimeters deep (Dra. Gerusa Steffen et al.).



# Carbon dioxide in cells



## Basal respiration (mg C-CO<sub>2</sub> Kg<sup>-1</sup> dia<sup>-1</sup>)

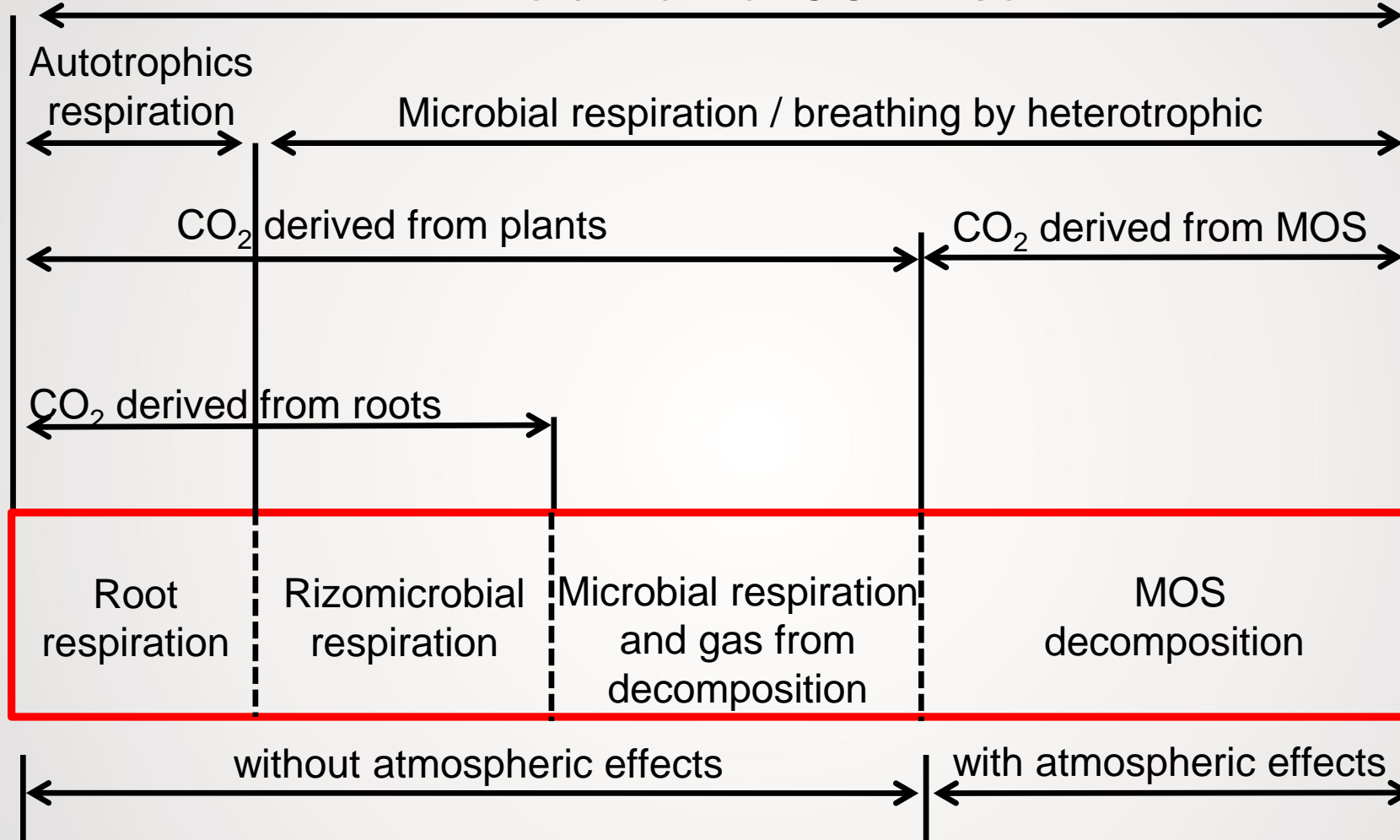


Basal respiration (mg C-CO<sub>2</sub> Kg<sup>-1</sup> dia<sup>-1</sup>) observed in plots containing soybeans submitted to different treatments. Columns with the same letter do not differ statistically by the Tukey test at 5% probability. (CV 9,38%)





# Total flow of CO<sub>2</sub> in soil



Positive effect of the increase in carbon dioxide concentration in crops (increase in the photosynthetic process).

Crop	Increase in the photosynthetic process (%)	Paper published
Rice	34,3	137
Wheat	33	214
Corn	21,3	20
Soybean	47,6	162
Bean	64,3	17
Potato	29,5	33
Tomato	31,9	35
Carrot	77,8	5
Grape	59,8	8

Source: [www.co2science.org/data/plant\\_growth](http://www.co2science.org/data/plant_growth)



# Petri glass Experiment with Penergetic



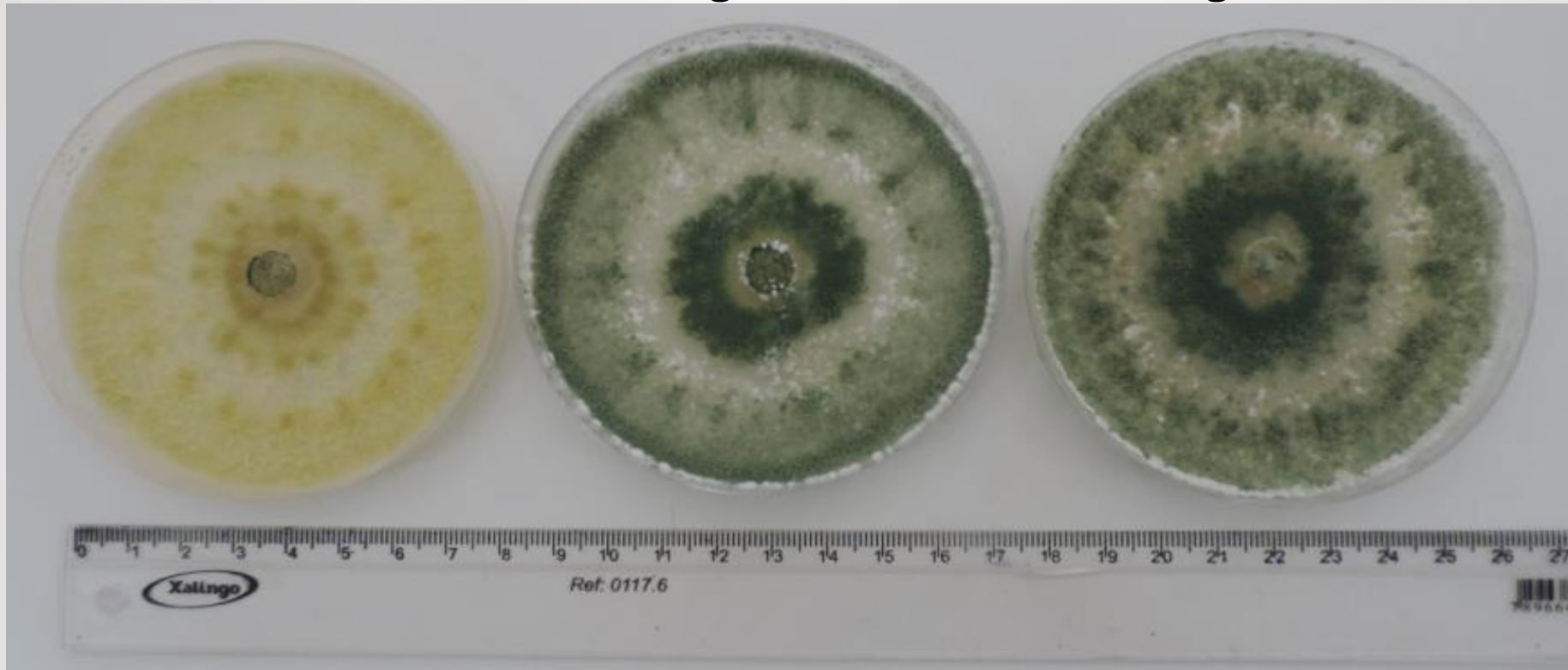
# Penergetic Kompost doses on the *Trichoderma* sp. growth

96 hours after inoculation

Control

1 g/L

2 g/L



*In vitro* growth of *Trichoderma* sp. (isolate 2) in the culture medium containing different concentrations of Penergetic Kompost. (Gerusa Steffen and Joseila Maldaner).



# Penergetic Kompost concentrations on the *Pisolythus microcarpus* growth

28 days after inoculation



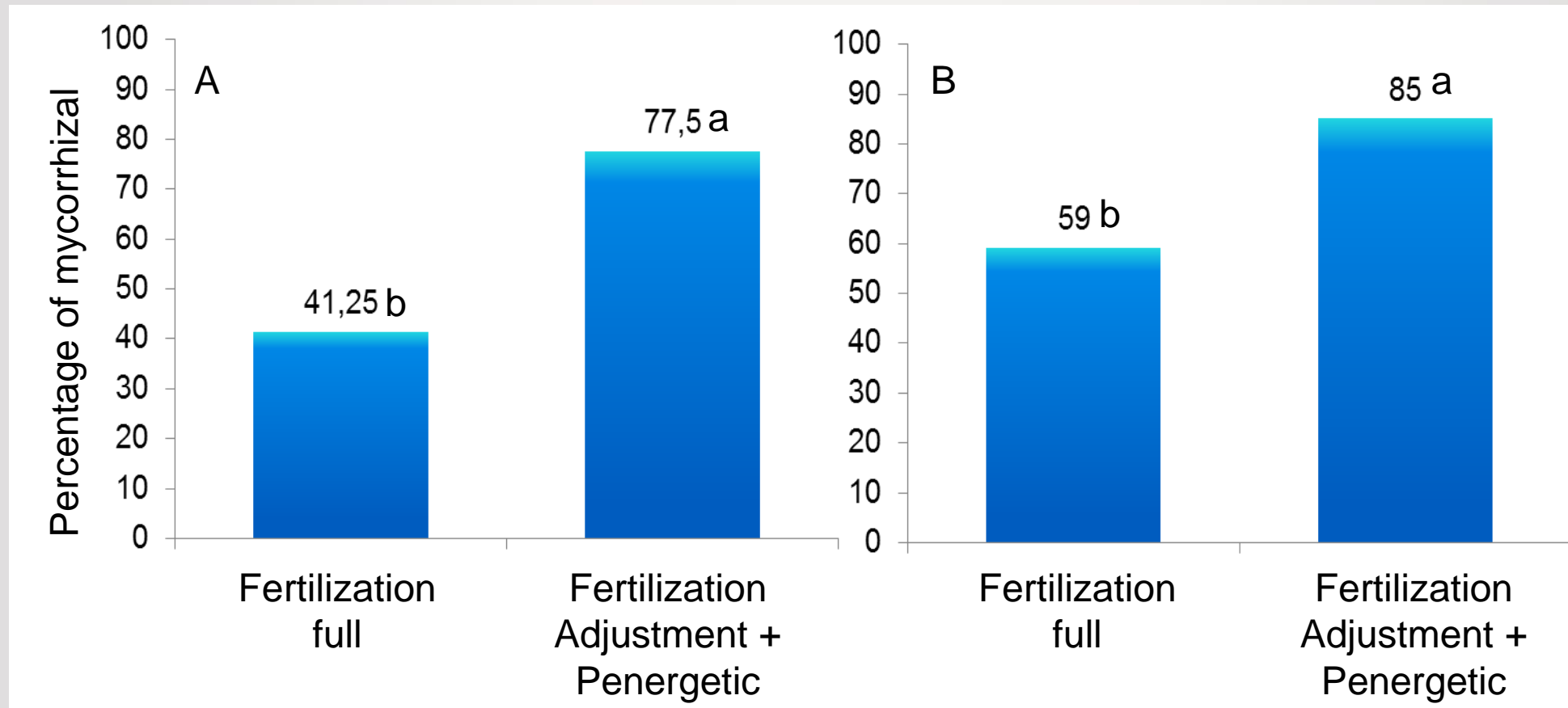
**Control**

**Penergetic K  
1g / L**

**Penergetic K  
2 g / L**

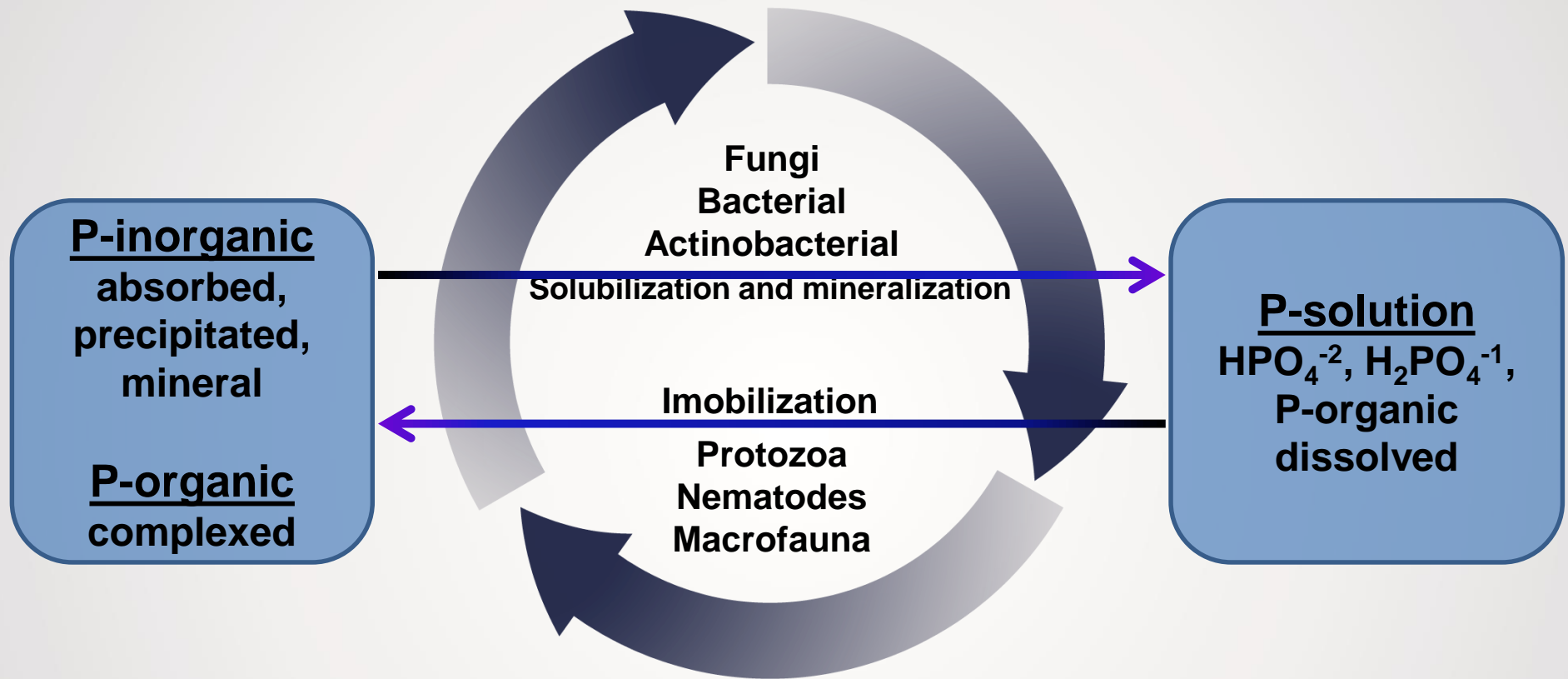


# Effect on mycorrhizal



Mycorrhization in roots of (A) **wheat cultivar Quartz** and (B) **soybean cultivar Nidera 5909**, the flowering stage, the different treatments. Mean of 5 replicates.





Schematic representation of the microorganisms importance for the phosphorus availability in the soil.



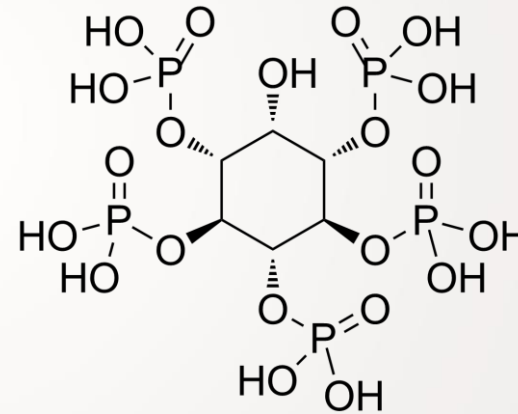
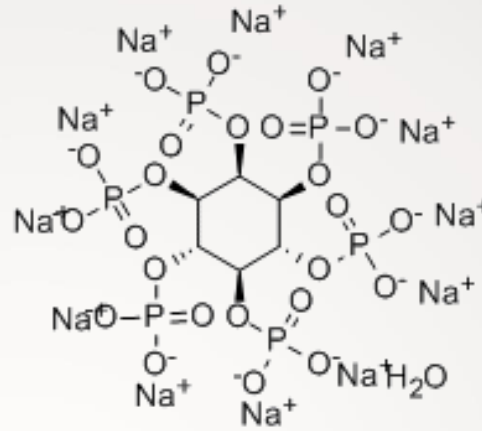
# Phosphate solubilizers

## Bacterial:

*Bacillus, Thiobacillus, Mycobacterium, Micrococcus, Flavobacterium, Enterobacter, Arthrobacter, Alcaligenes, Pseudomonas, Nitrobacter, Escherichia, Agrobacterium, Achromobacter, Erwinia, Brevibacterium.*

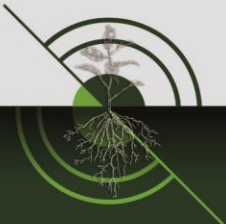
## Fungi:

*Aspergillus, Penicillium, Sclerotium, Rhizopus, Candida, Oidiodendron, Pseudogymnoascus, Trichoderma, Chaetomium, Fusarium, Stachybotrys, Cunninghamella, Thielavia, Mucor, Coniothyrium*



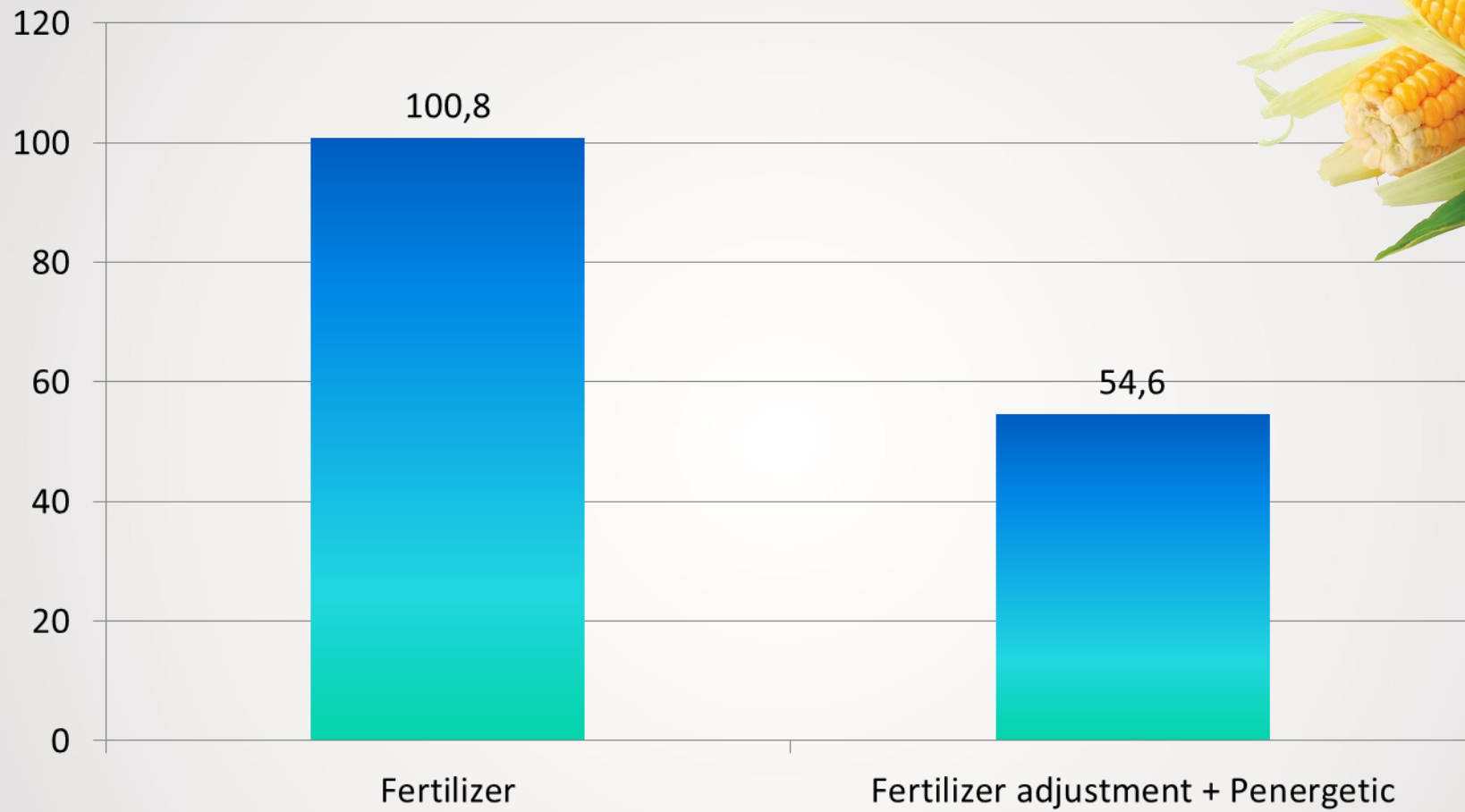
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**50 – 90% of P<sub>2</sub>O<sub>5</sub> is not available for plant**





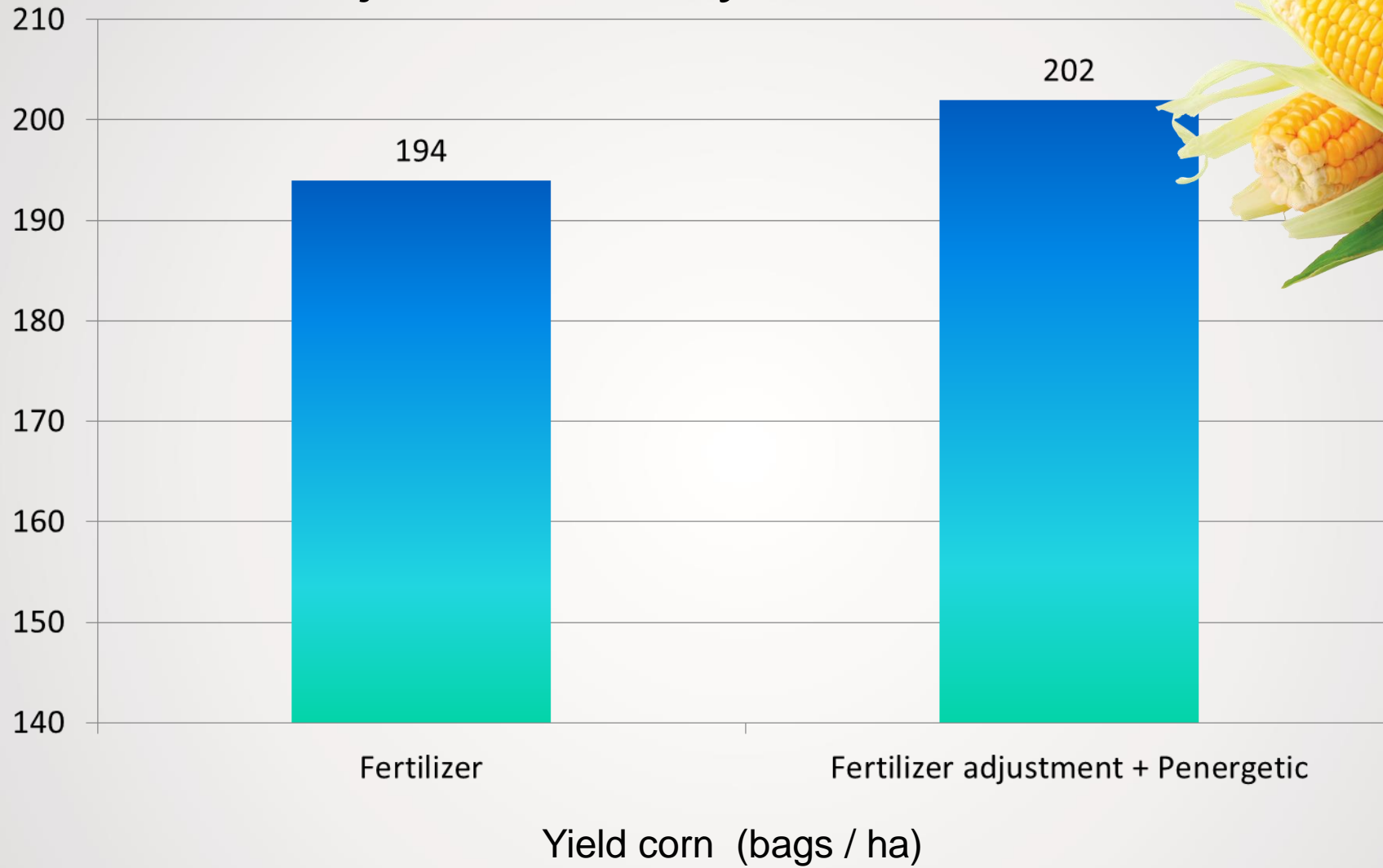
# Effect on fertilizer adjustment



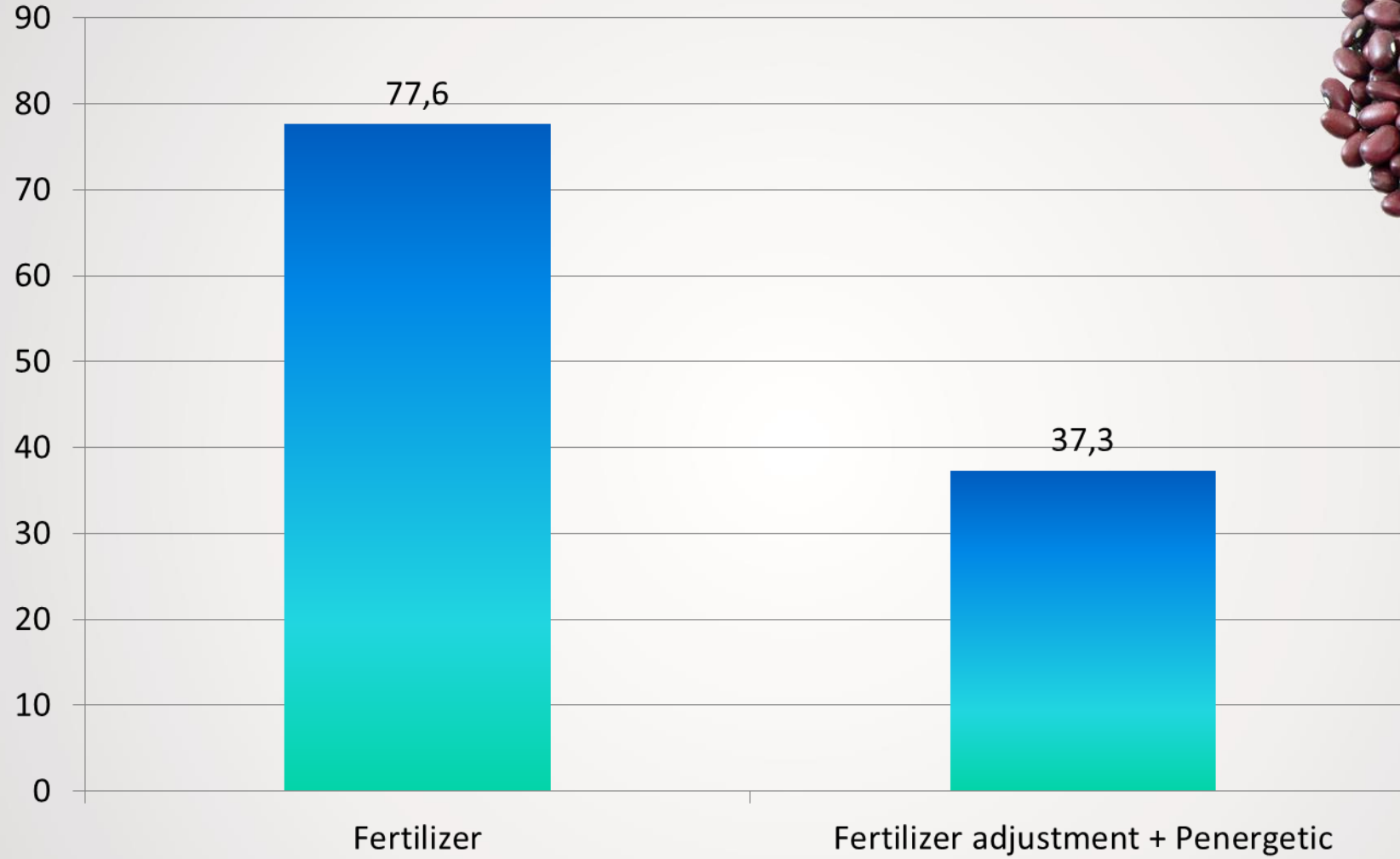
Decrease in phosphorus fertilizer in corn (kg of P<sub>2</sub>O<sub>5</sub> / ha).



# Effect on fertilizer adjustment in yield



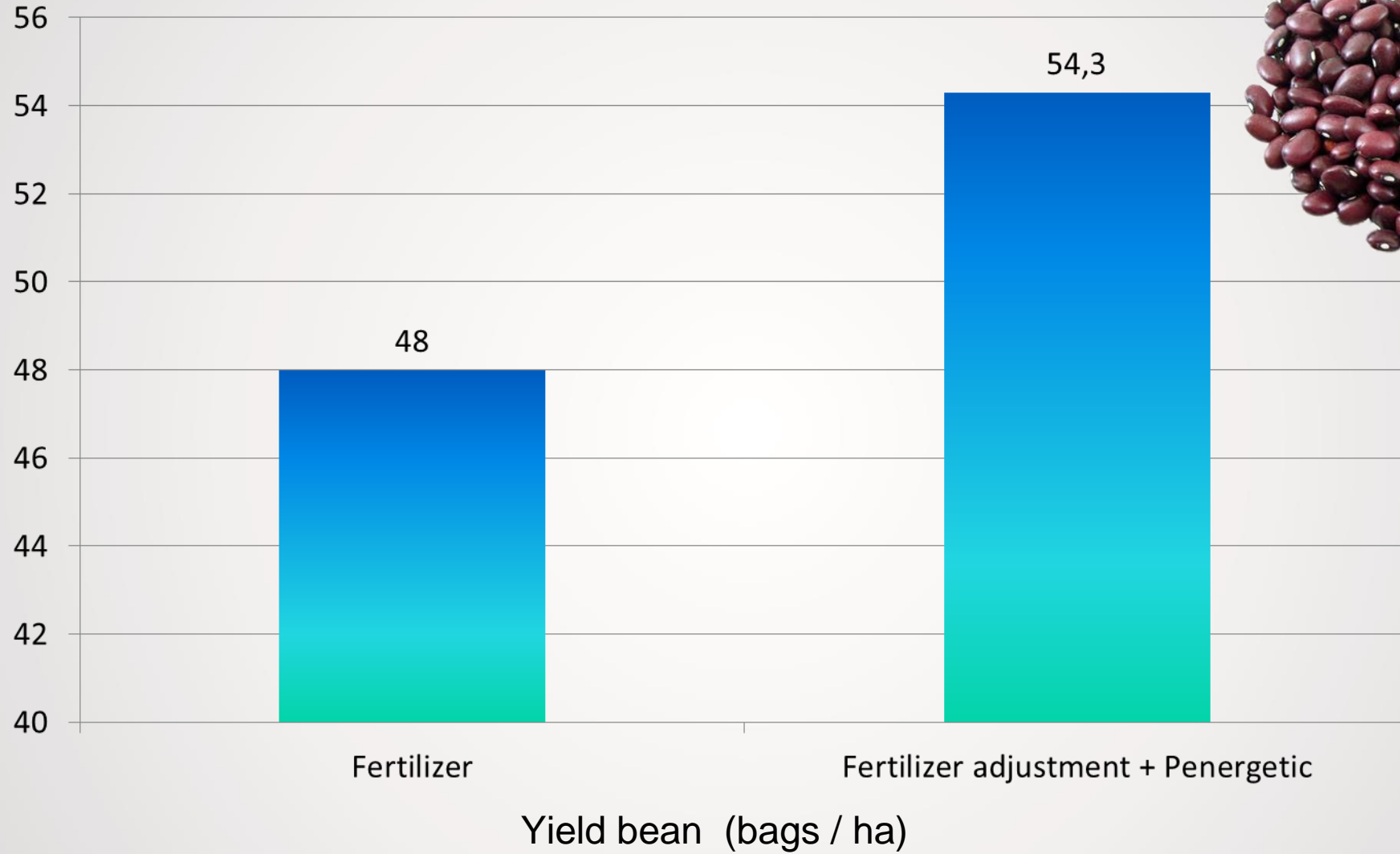
# Effect on fertilizer adjustment



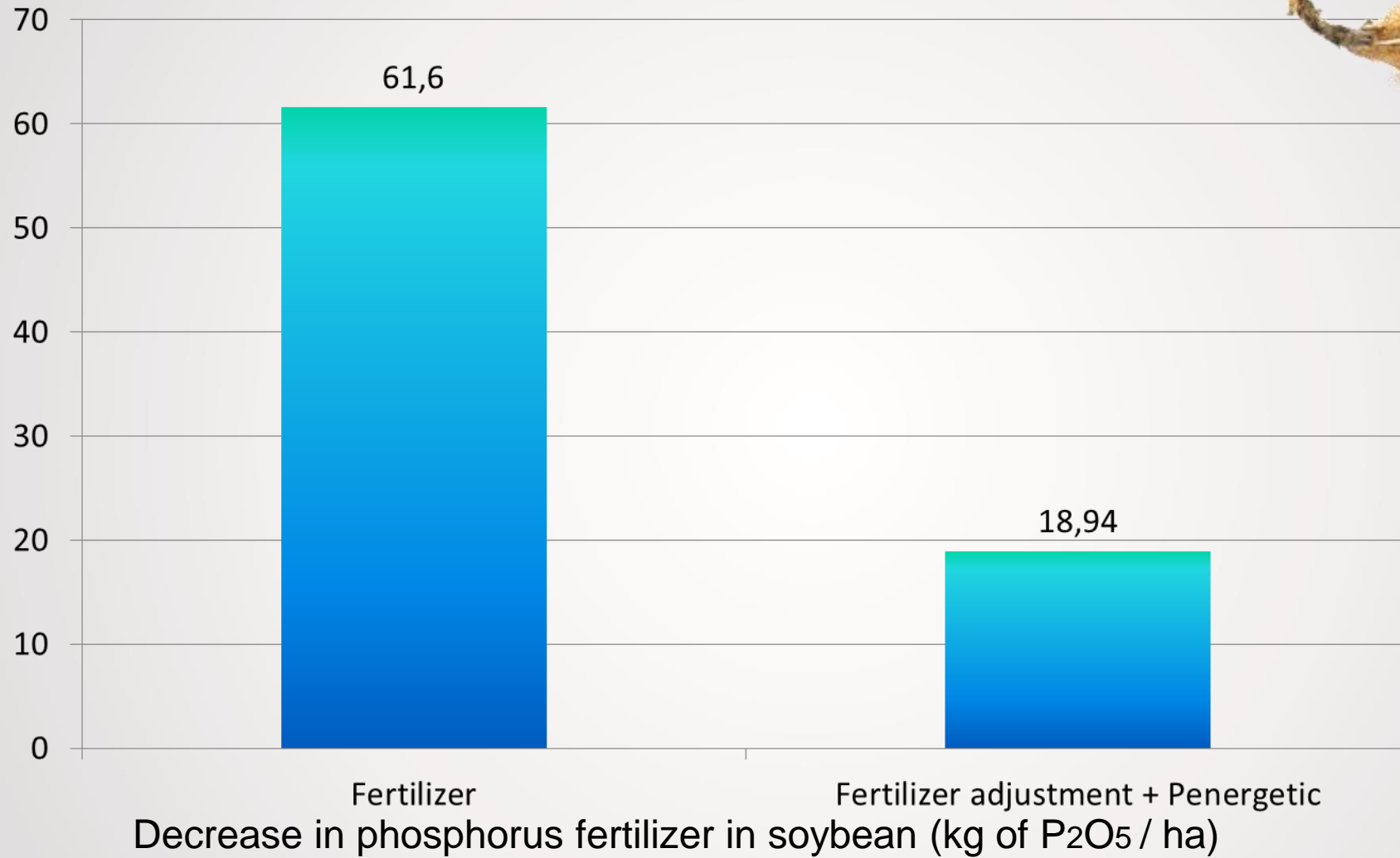
Decrease in phosphorus fertilizer in bean (kg of P<sub>2</sub>O<sub>5</sub> / ha)



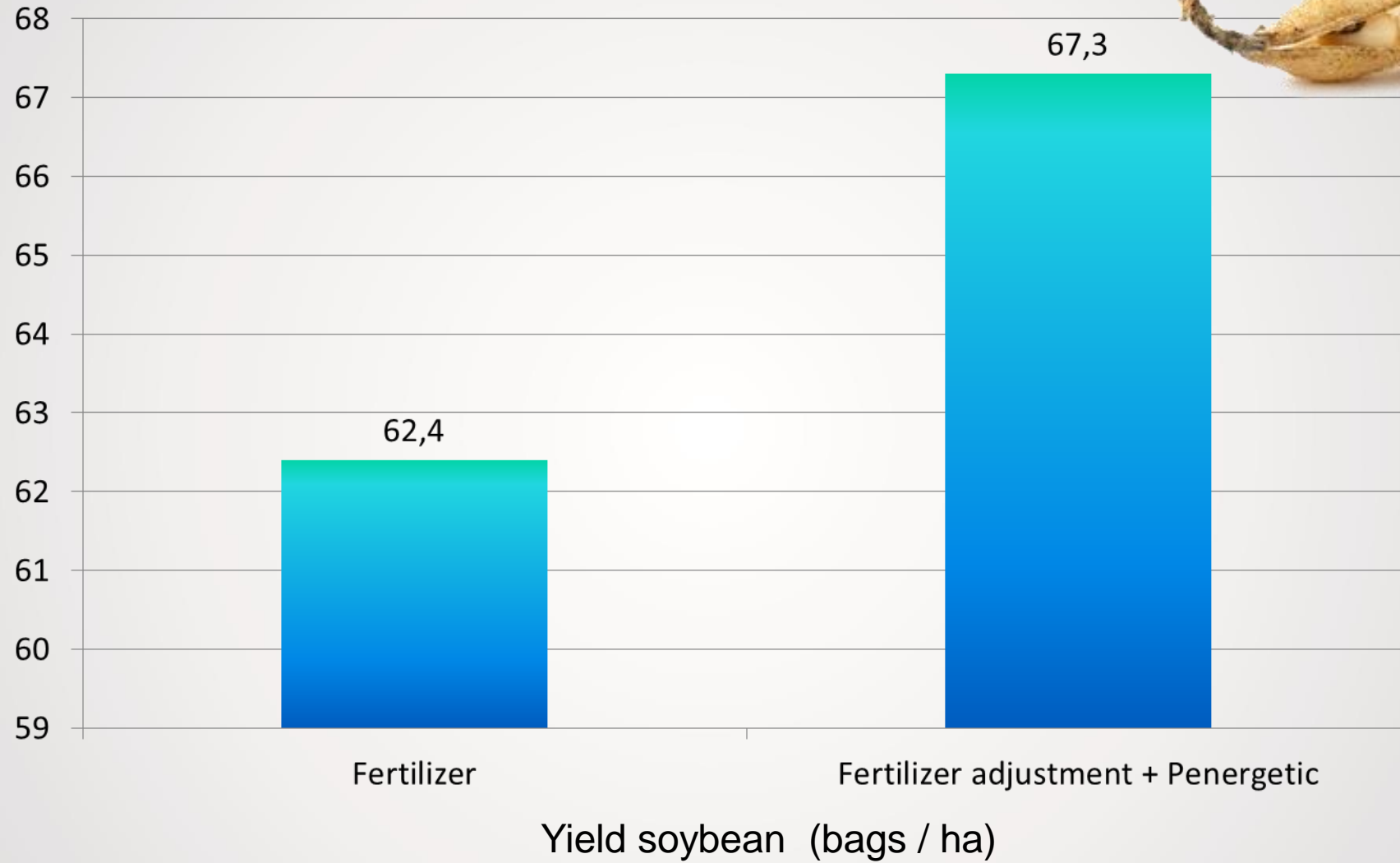
# Effect on fertilizer adjustment in yield

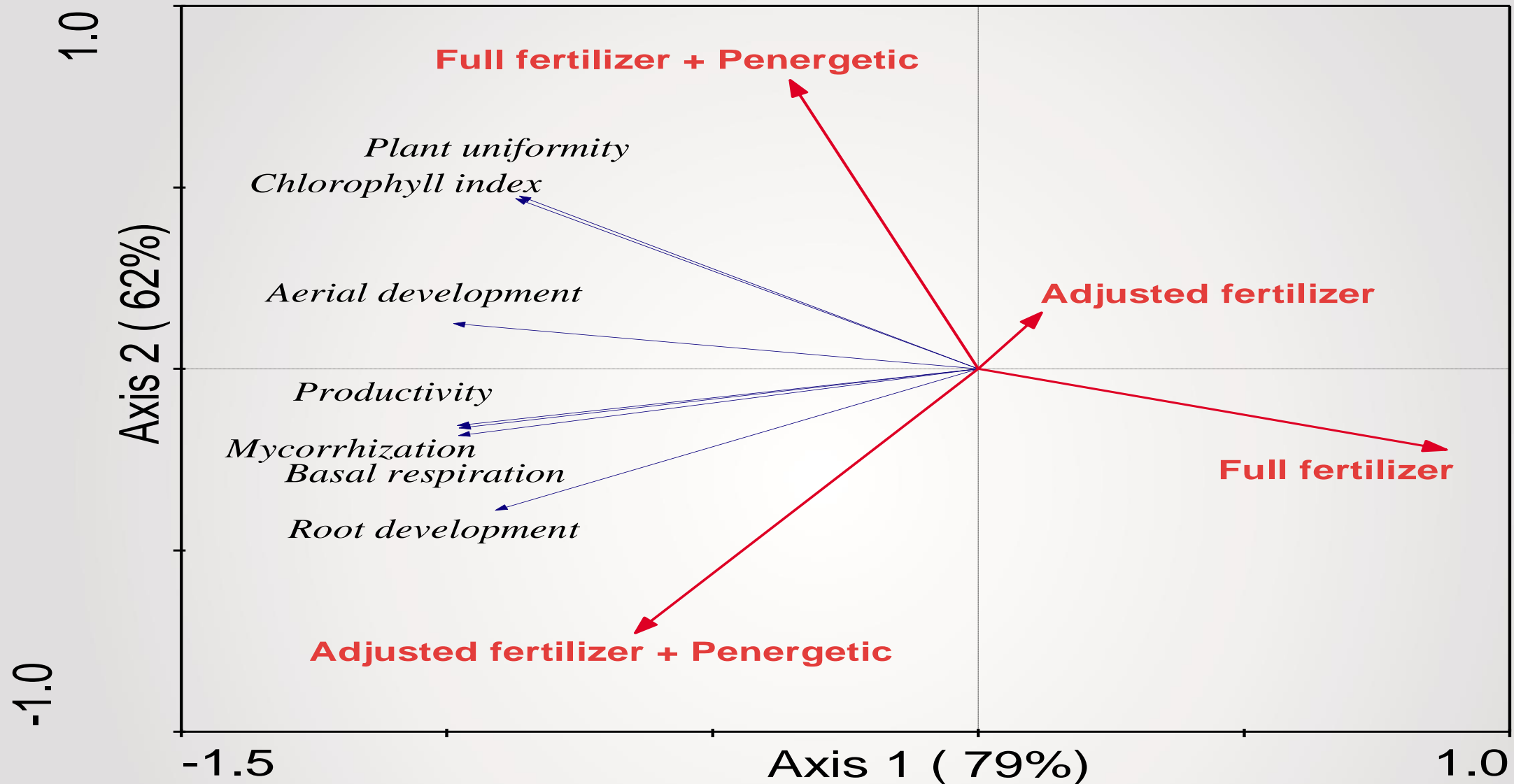


# Effect on fertilizer adjustment



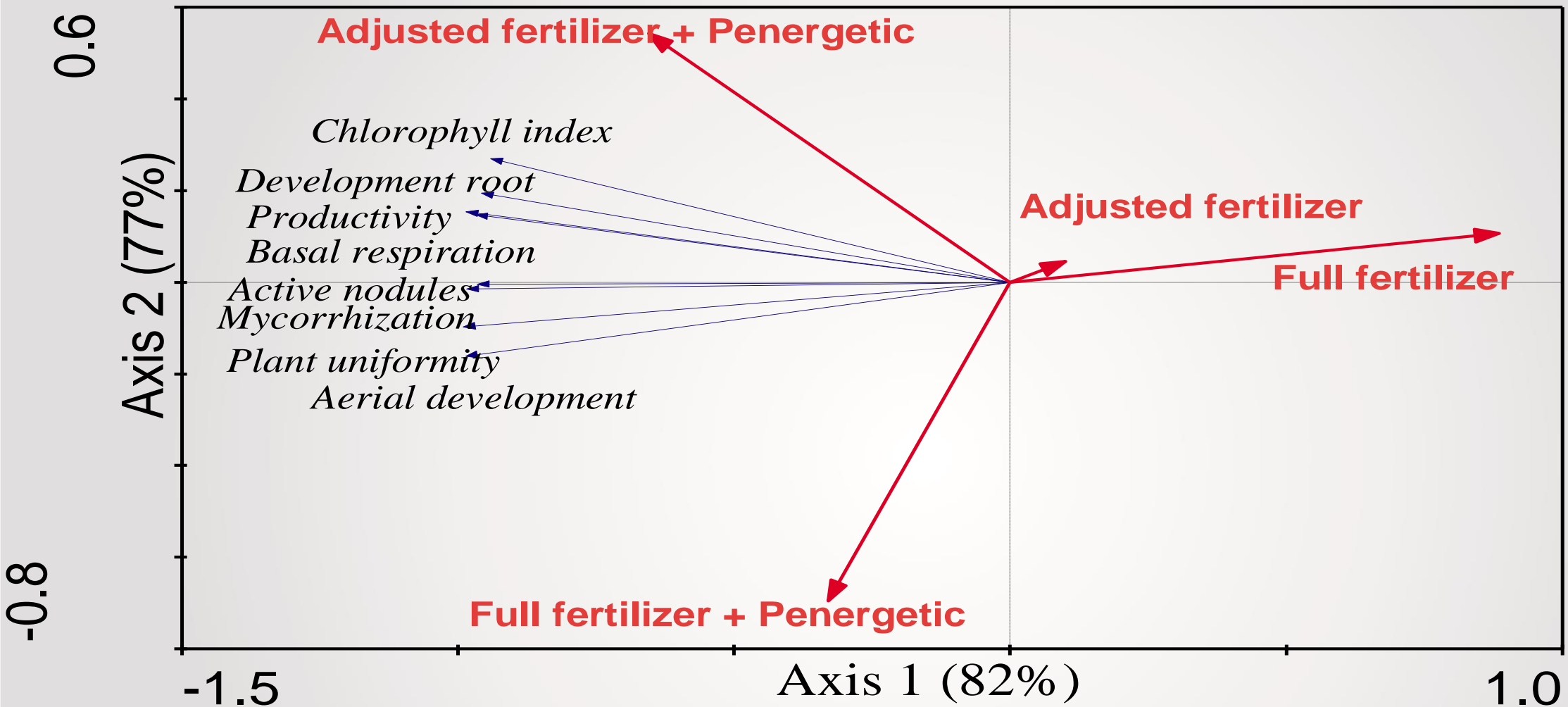
# Effect on fertilizer adjustment in yield





Principal components analysis (PCA) demonstrating the effect of different treatments on mycorrhizal symbiosis, soil microbial activity, development and yield of corn crop .





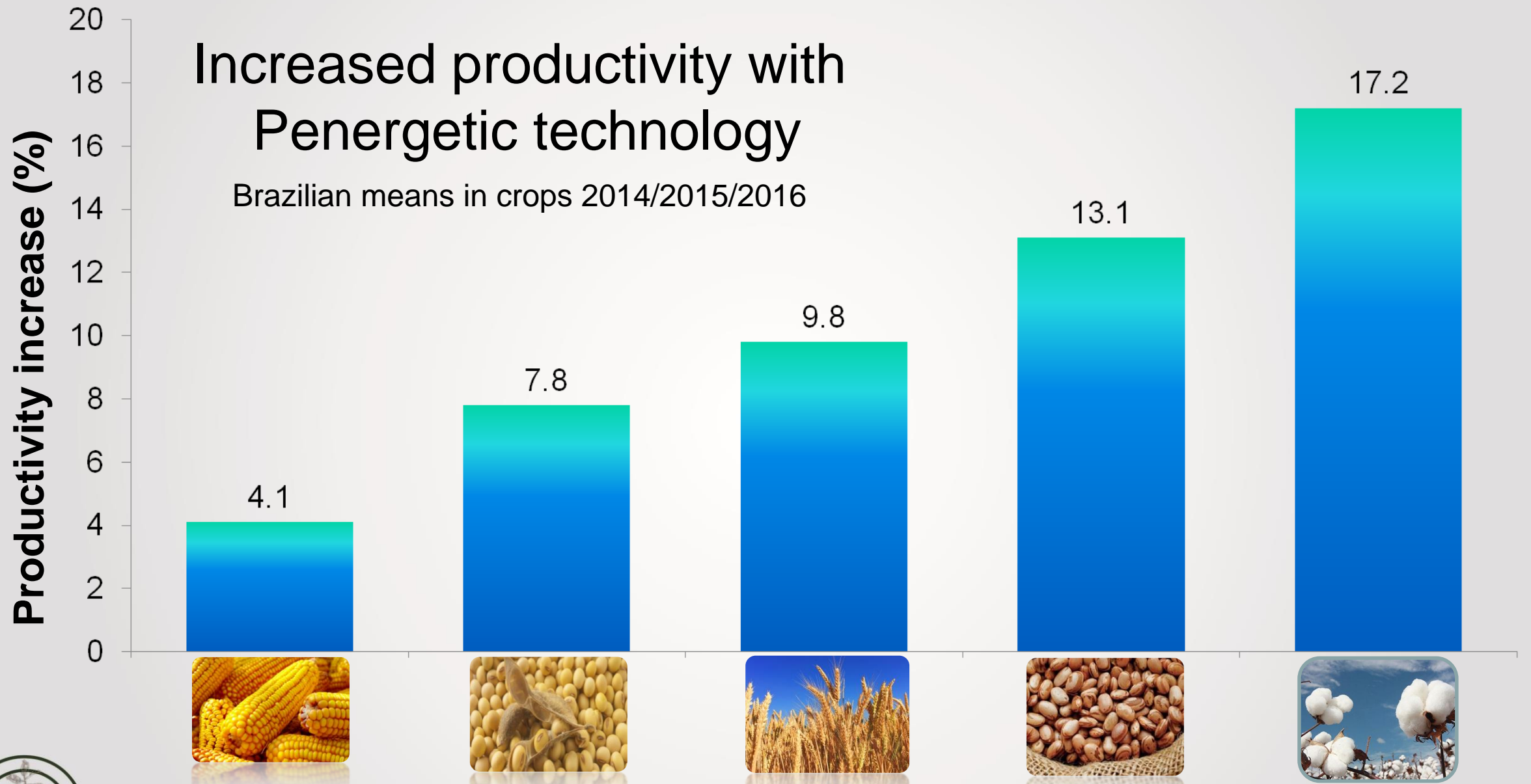
Principal components analysis (PCA) demonstrating the effect of different treatments on mycorrhizal symbiosis, soil microbial activity, development and yield of soybean crop .





# Increased productivity with Penergetic technology

Brazilian means in crops 2014/2015/2016



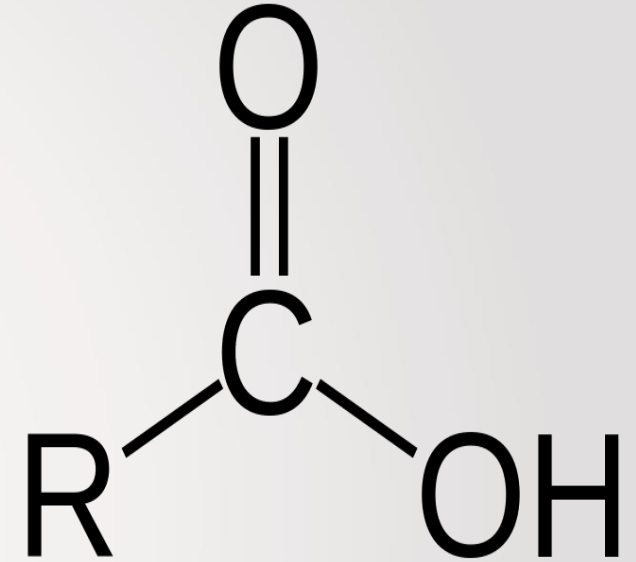
The roots of plants release organic acids of agricultural interest.

- ✓ Citric, malic, oxalic, butyric, acetic and lactic acids are released by the roots, acting on the availability of nutrients such as phosphorus, potassium and zinc.



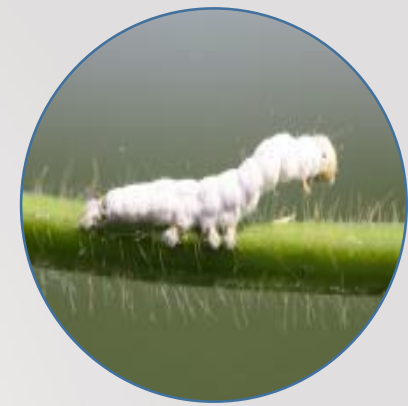
# Release of organic acids by acceleration decomposition of organic waste.

- ✓ Improves nutrient efficiency;
- ✓ Promotes balance in the rhizosphere;
- ✓ Equilibrium of microbial activity;
- ✓ Root nematode control by starvation.



Increased efficiency of products used for the biological control of pests and diseases.

- ✓ Stimulus to the development of symbiotic organisms;
- ✓ Equilibrium of microbial activity;
- ✓ Pest and soil disease control.



## Activation of rhizospheric microorganisms.

- ✓ Protection of the root system against soil pathogens;
- ✓ Increased processes of solubilization and availability of nutrients;
- ✓ Release of phyto-hormones;



## Activation of mycorrhizal fungi.



Non-mycorrhizal root



Mycorrhizal root

- ✓ Increase in the volume of soil explored by the roots;
- ✓ Resistance to stress and diseases;
- ✓ Carbon and energy sources for plants;
- ✓ Stabilizers of vegetable production.



# Soil organisms and microorganisms act in the Nutrient cycling.



The silent action of Soil microorganisms results in the soil disturbance of approximately 500 tons of soil per hectare per year, providing nutrients for plants.



# Penergetic effects in the field

- Increased microbial activity
- Acceleration of metabolism
- Efficiency in nutrient absorption
- Increase in available carbohydrates
- Increased fungal symbiosis
- Increased availability of P and Ca
- Favoring the absorption of Zn and Mn
- Reduction of severity of fungal diseases
- Optimization of the photosynthetic process





# Penergetic effects in the field

- Increase in plant biomass
- Optimization of nitrogen utilization
- Dynamics of phosphorus absorption
- Microbial interaction (equilibrium)
- Plant-Plant Interaction
- Vegetative growth (leaf area)
- Increase in nitrogen cycling
- Nodulation stimulation
- Optimization of water use



# Penergetic effects in the field

**Hormonal balance**

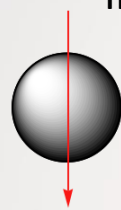
**Microbial balance**

**Increasing crop productivity**

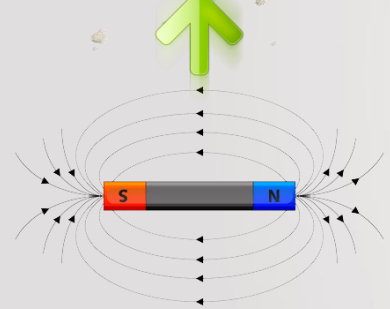
**penergetic**  **solos** Kompost **penergetic**  **plantas** Pflanzen



# In short...



Information storage  
in the spin

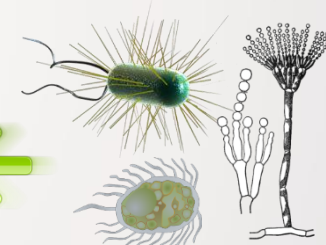
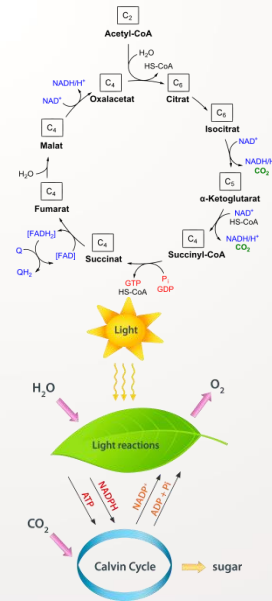
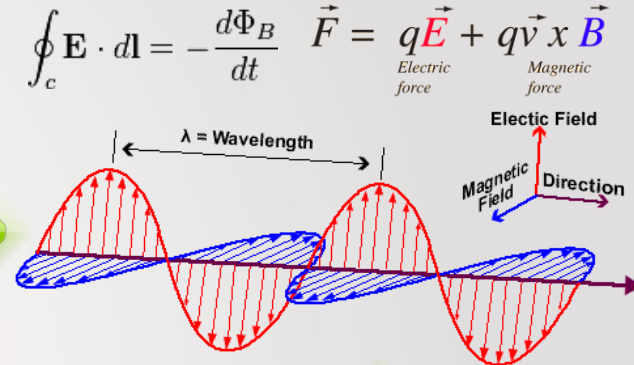
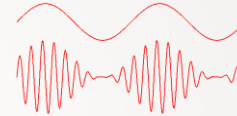


$$\omega_{electron\ spin} = \frac{2\mu_e B}{\hbar} = \frac{2 \cdot 2 \cdot \frac{1}{2} (5.79 \times 10^{-5} eV / T)(1T)}{6.58 \times 10^{-16} eV \cdot s} = 1.7608 \times 10^{11} s^{-1}$$

$$\nu = \frac{\omega}{2\pi} = 28.025\text{ GHz} \quad \text{Larmor frequency}$$

$$\omega_{proton\ spin} = \frac{2\mu_p B}{\hbar} = \frac{2(2.79)(3.15 \times 10^{-8} eV / T)(1T)}{6.58 \times 10^{-16} eV \cdot s} = 2.6753 \times 10^8 s^{-1}$$

$$\nu = \frac{\omega}{2\pi} = 42.5781\text{ MHz} \quad \text{Larmor frequency}$$

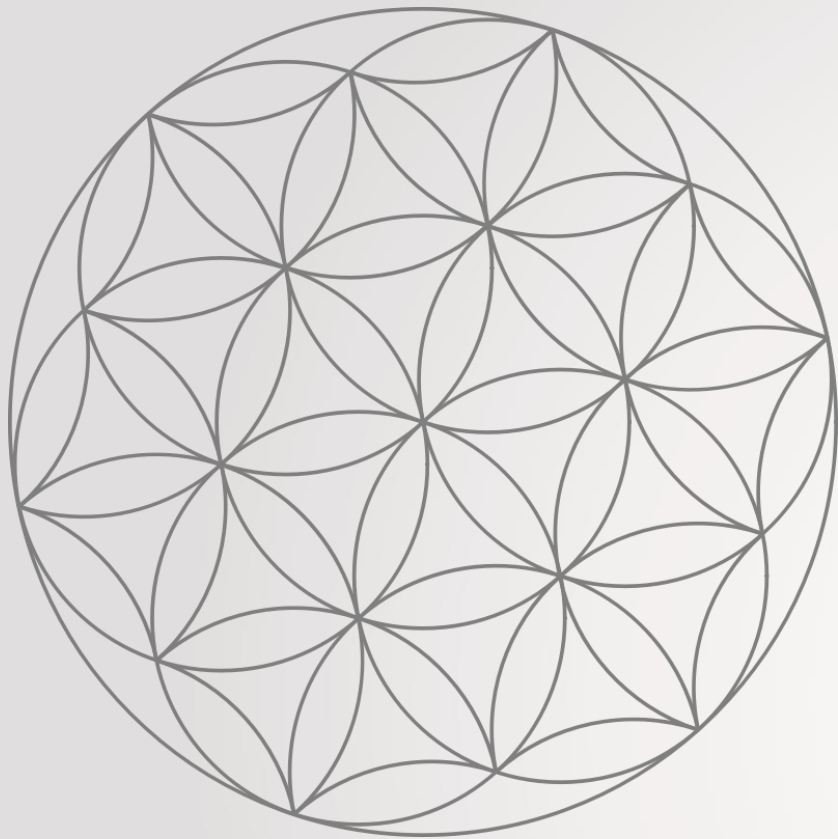


Penergetic-k



Penergetic-p





# Thanks for attention

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*“The mind that opens to a new idea  
never returns to its original size.”*

