



Regenerative Banana Cropping Systems: Great leverage for Sustainability in the Tropics

Lieselot Van der Veken PhD



Itinerary

- WHY?
- Global challenges: the DONUT as tangeable model
- Journey of reconnection:
 - BC in banana: transition pilot case in the tropical field
 - General principles and proof of BC role to adress global challenges
- Perspectives

WHY?



“We do not inherit the Earth from our ancestors;
we borrow it from our children”

WHY?

UN report 2017

Pesticides

UN experts denounce 'myth' pesticides are necessary to feed the world

Report warns of catastrophic consequences and blames manufacturers for 'systematic denial of harms' and 'unethical marketing tactics'

This article is 2 months old
88,777 389
Damian Carrington
@dpcarrington
Tuesday 7 March 2017 11:37 GMT



The global pesticides market is worth \$50bn and companies lobby heavily to resist reforms and regulations. Photograph: Philippe Huguen/AFP/Getty Images

The idea that pesticides are essential to feed a fast-growing global population is a myth, according to UN food and pollution experts.

A new report, being presented to the UN human rights council on Wednesday, is severely critical of the global corporations that manufacture pesticides, accusing them of the "systematic denial of harms", "aggressive, unethical marketing tactics" and heavy lobbying of governments which has "obstructed reforms and paralysed global pesticide restrictions".

The report says pesticides have "catastrophic impacts on the environment, human health and society as a whole", including an estimated 200,000 deaths a year from acute poisoning. Its authors said: "It is time to create a global process to transition toward safer and healthier food and agricultural production."

The world's population is set to grow from 7 billion today to 9 billion in 2050. The pesticide industry argues that its products - a market worth about \$50bn (£41bn) a year and growing - are vital in protecting crops and ensuring sufficient food supplies.

"It is a myth," said Hilal Elver, the UN's special rapporteur on the right to food. "Using more pesticides is nothing to do with getting rid of hunger. According to the UN Food and Agriculture Organisation (FAO), we are able to feed 9 billion people today. Production is definitely increasing, but the problem is poverty, inequality and distribution."

Elver said many of the pesticides are used on commodity crops, such as palm oil and soy, not the food needed by the world's hungry people: "The corporations are not dealing with world hunger, they are dealing with more agricultural activity on large scales."

The new report, which is co-authored by Baskut Tuncak, the UN's special rapporteur on toxics, said: "While scientific research confirms the adverse effects of pesticides, proving a definitive link between exposure and human diseases or conditions remains a considerable challenge. This

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Erdoğan's bodyguards' in violent clash with protesters in Washington DC

What would happen if Donald Trump were impeached?

Student who stabbed boyfriend may avoid jail as it would 'damage her career'

WHY?


- “Chronic exposure to pesticides has been linked **to cancer, Alzheimer’s and Parkinson’s** diseases, hormone disruption, developmental disorders and sterility.” It also highlighted the **risk to children** from pesticide contamination of food

The UN report says pesticides have “**catastrophic impacts on the environment, human health and society as a whole**”, including an estimated **200,000 deaths a year** from acute poisoning. Its authors said:

“**It is time to create a global process to transition toward safer and healthier food and agricultural production.**”

EP High level webinar 2022

Viewing SPAAK 05B001 DGLINC's screen



The hidden cost of pesticide use on human health and the environment

David Cary
Advisor to MPPP Task Force
Member of the Board PAN Europe

MICROBIAL PLANT PROTECTION PRODUCTS TASK FORCE

SPAAK 05B001 DGLINC



Mark Eyskens

SPAAK 05B001 DGLINC	DS DGITEC-MEP I... (Host)
JS Jiri Sir	JC Jose Carvalho
KM Karen Meesen	MP maria pulina

SILENT SPRING



*The CLASSIC that LAUNCHED
the ENVIRONMENTAL MOVEMENT*

RACHEL CARSON

Introduction by LINDA LEAR *Afterword by* EDWARD O. WILSON

60 years ago, EPA officer Rachel Carson described the devastating consequences of post WO II aerial chemical pesticide spraying
As EPA reports of dead fish, birds, mammals from all over the US arrive, they add up to a silent spring...

Back in the 1960s:



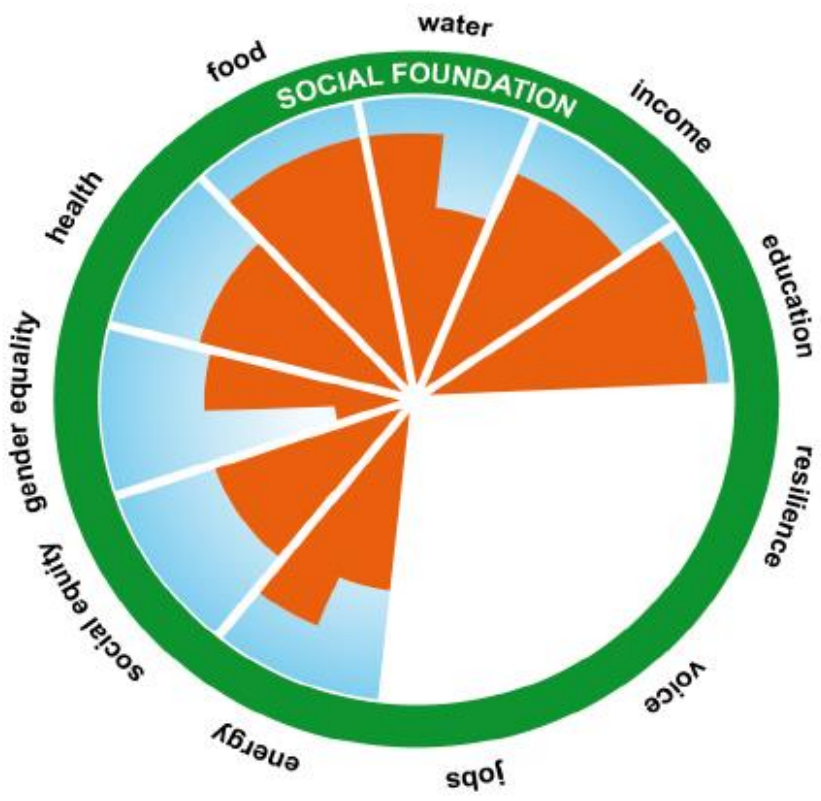
“I am pessimistic about the human race because it is too ingenious for its own good. Our approach to nature is to beat it into submission. We would stand a better chance of survival if we accommodated ourselves to this planet and viewed it appreciatively, instead of skeptically and dictatorially.”

– E.B. White

Global challenges we are facing today

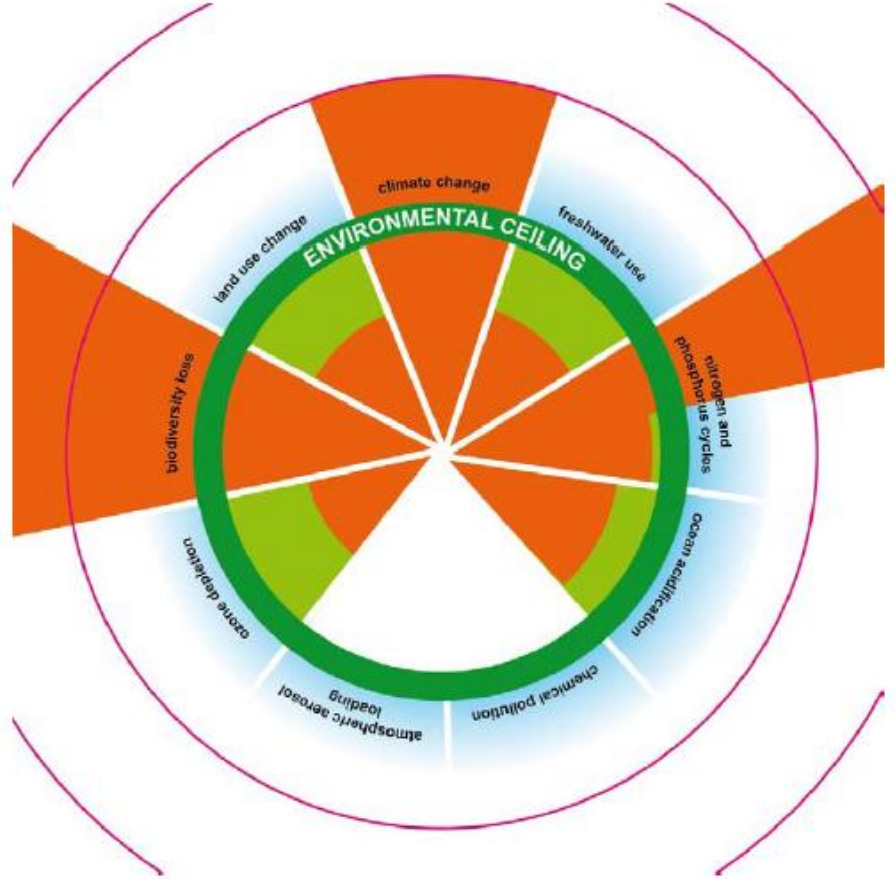
SOCIAL FOUNDATIONS for mankind within the PLANETARY BOUNDARIES

Figure 2. Falling below the social foundation: An illustrative assessment based on Rio+20 priorities



Source: Oxfam, based on data in Table 1 above. Social dimensions with two indicators in Table 1 are represented by split wedges, showing both of the deprivation gaps.

Figure 3. Breaching planetary boundaries



Source: Rockström et al (2009b), based on Table 2 above.

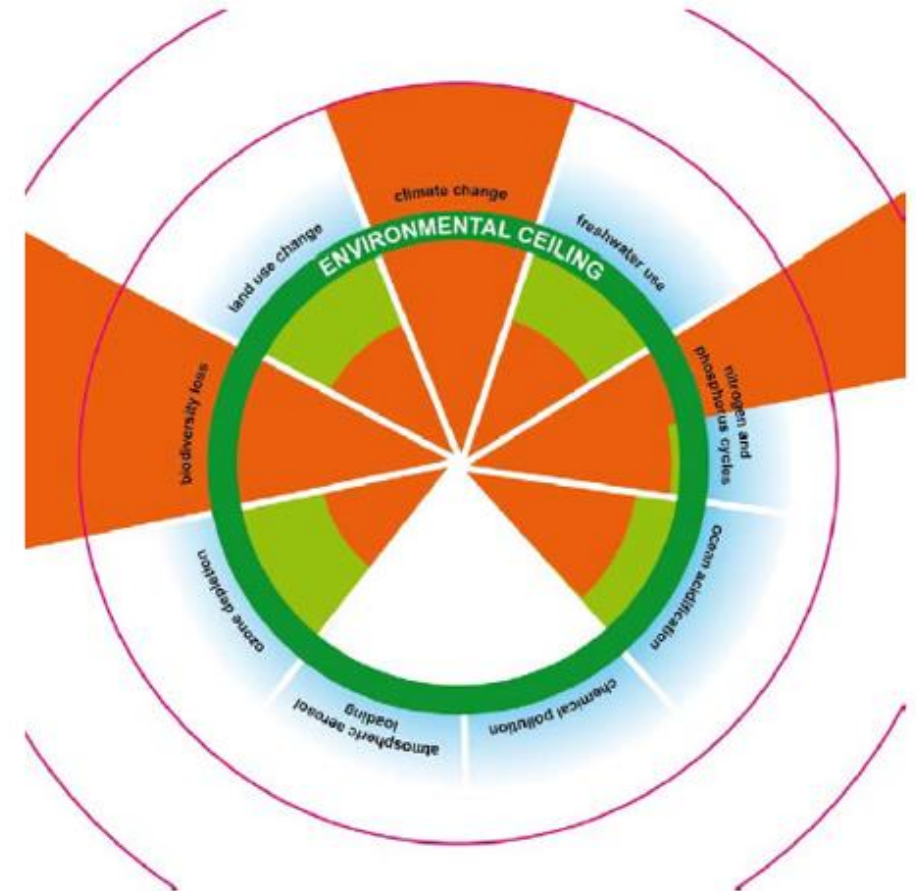
Conventional agriculture's impact on the planet

Planetary boundaries

- 20-25% of greenhouse gasses
- Biodiversity loss 52% (tssn 1970-2009):
100-1000 x faster than any background extinction (De Vos, Joppa, Gittleman, Stephens, & Pimm, 2014)
- N,P cycli (release of P/N in our ecosystem)
- Human and environmental health (VN, 2017)



Figure 3. Breaching planetary boundaries



Source: Rockström et al (2009b), based on Table 2 above.

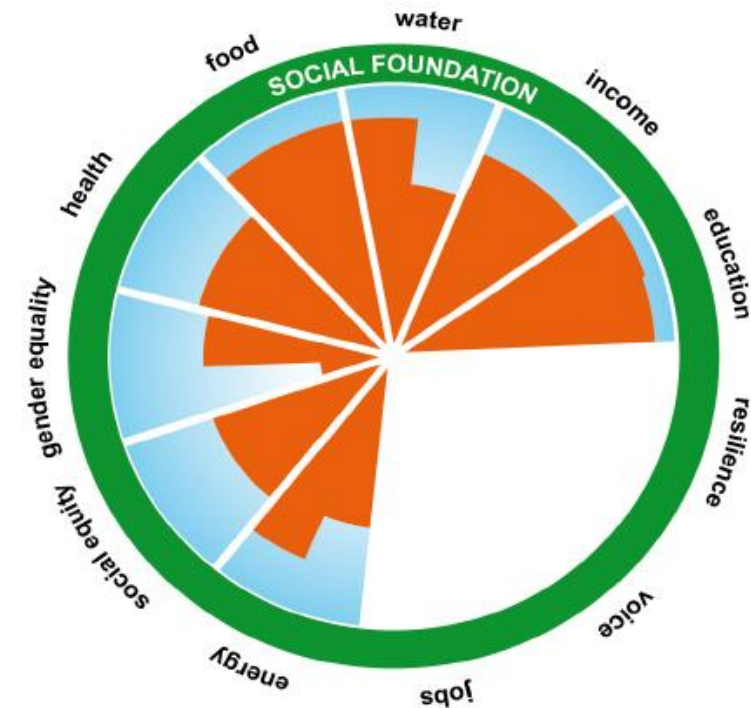
What RegAg (including biocontrol) can do for

social sustainability:

- Improvement of health by use of solutions with low impact for human and environmental health
- Improvement of food security through resilient production systems
- Improved margin from agriproduction
- Empowerment of women, small-holder farmers in the tropics
- Income for women means education for their children

Social foundations

Figure 2. Falling below the social foundation: An illustrative assessment based on Rio+20 priorities



Source: Oxfam, based on data in Table 1 above. Social dimensions with two indicators in Table 1 are represented by split wedges, showing both of the deprivation gaps.





This one is the old one and this is the new one

The benefits I get are food and being able to pay school fees for my children.

A SAFE AND JUST SPACE FOR HUMANITY

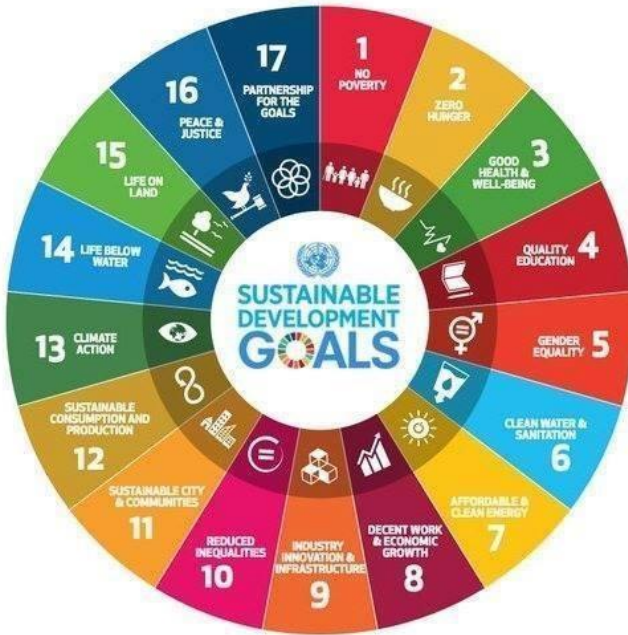
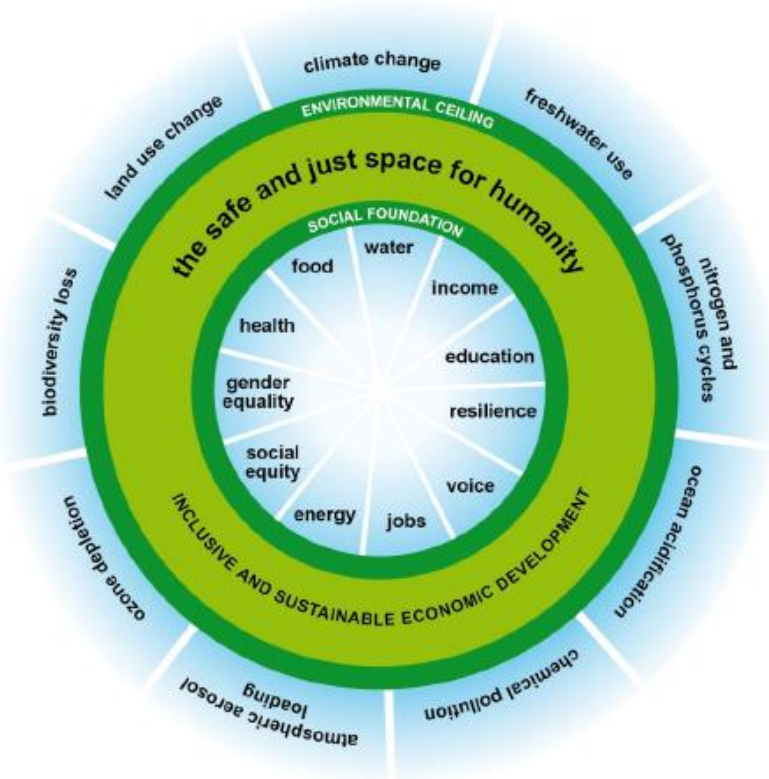
CAN WE LIVE WITHIN THE DOUGHNUT?



Humanity's challenge in the 21st century is to eradicate poverty and achieve prosperity for all within the means of the planet's limited natural resources

(K. Raworth, Oxfam 2012)

The space in which inclusive and sustainable economic development takes place.



Source: Oxfam. The 11 dimensions of the social foundation are illustrative and are based on governments' priorities for Rio+20. The nine dimensions of the environmental ceiling are based on the planetary boundaries set out by Rockström et al (2009b)



“We have broken the circle of Life”

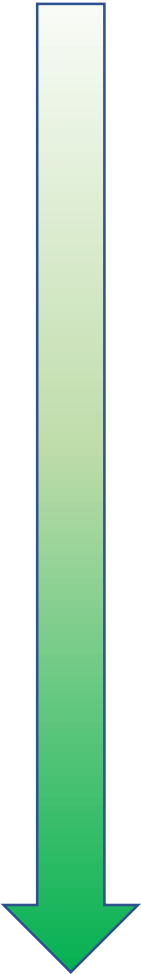
Working together to deliver healthy people and a healthy planet

Published on October 21, 2019

Time for transition to resilient regenerative cropping systems



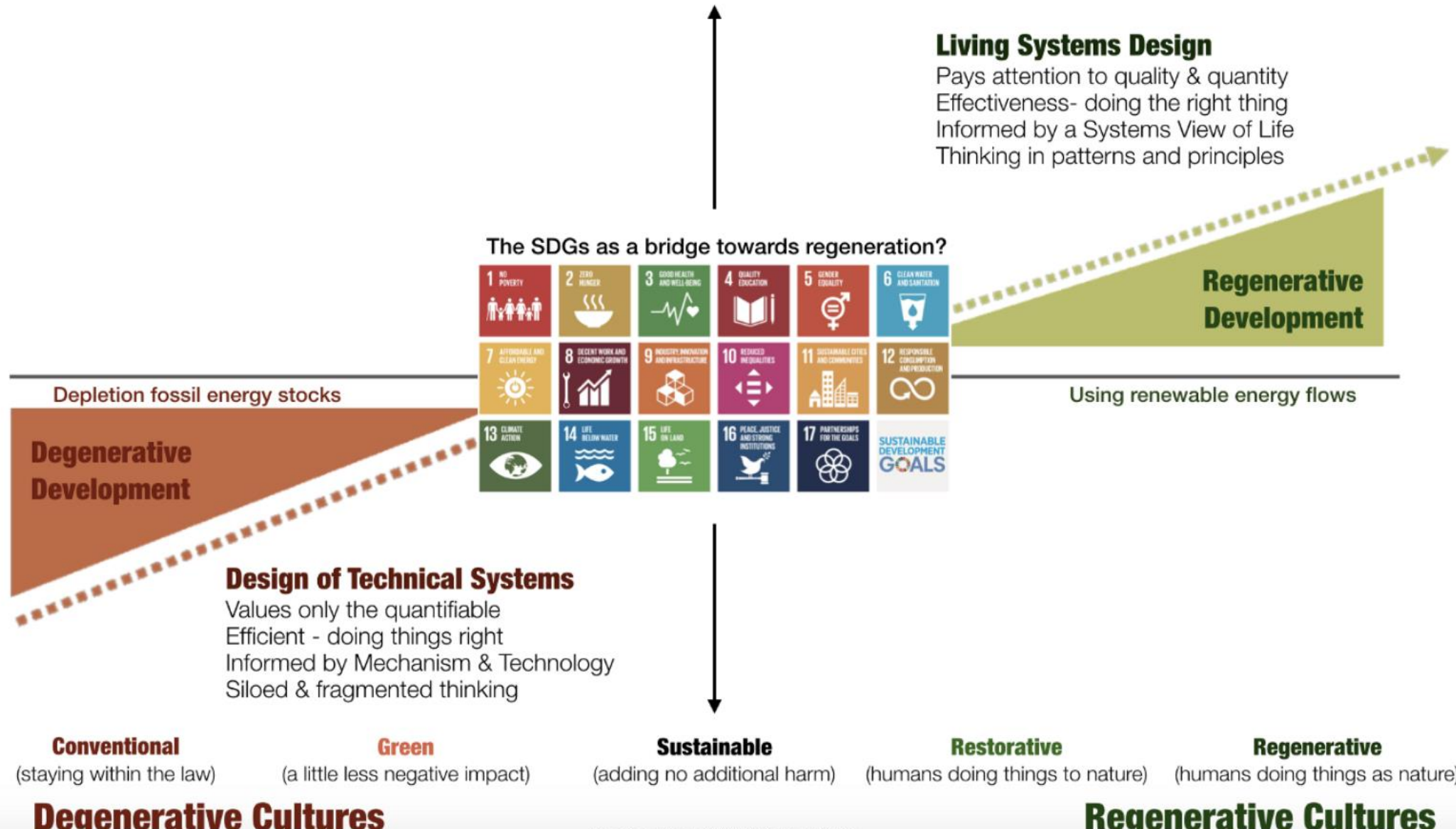
Transition

- 
- Conventional (monocropping- eradicate what You do not like) petroleum based inputs (fertilizers –PPP)
 - IPM (monocropping- cultural practices as preventative approach- biocontrol curative- agrochemicals as last resort)
 - IPM incorporating agro-ecological principles
 - Organic (no petroleum –based inputs allows for soil life to build up)
 - Regenerative organic (holistic approach with emphasis on soil-plant-human- health)

Product Substitution

System Approach

Beyond Sustainability: Designing Regenerative Cultures



Resilience

resilience:

“an ability to recover from or adjust easily to misfortune or change.”

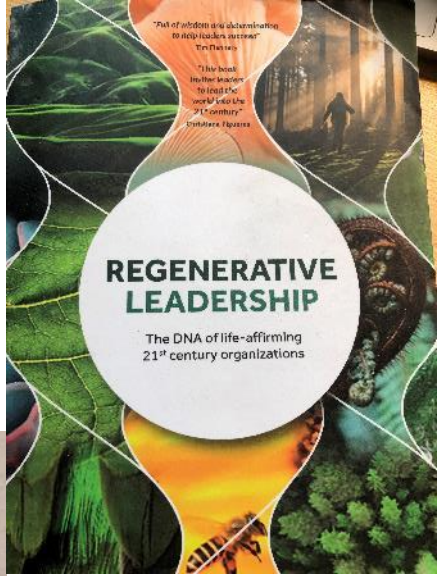
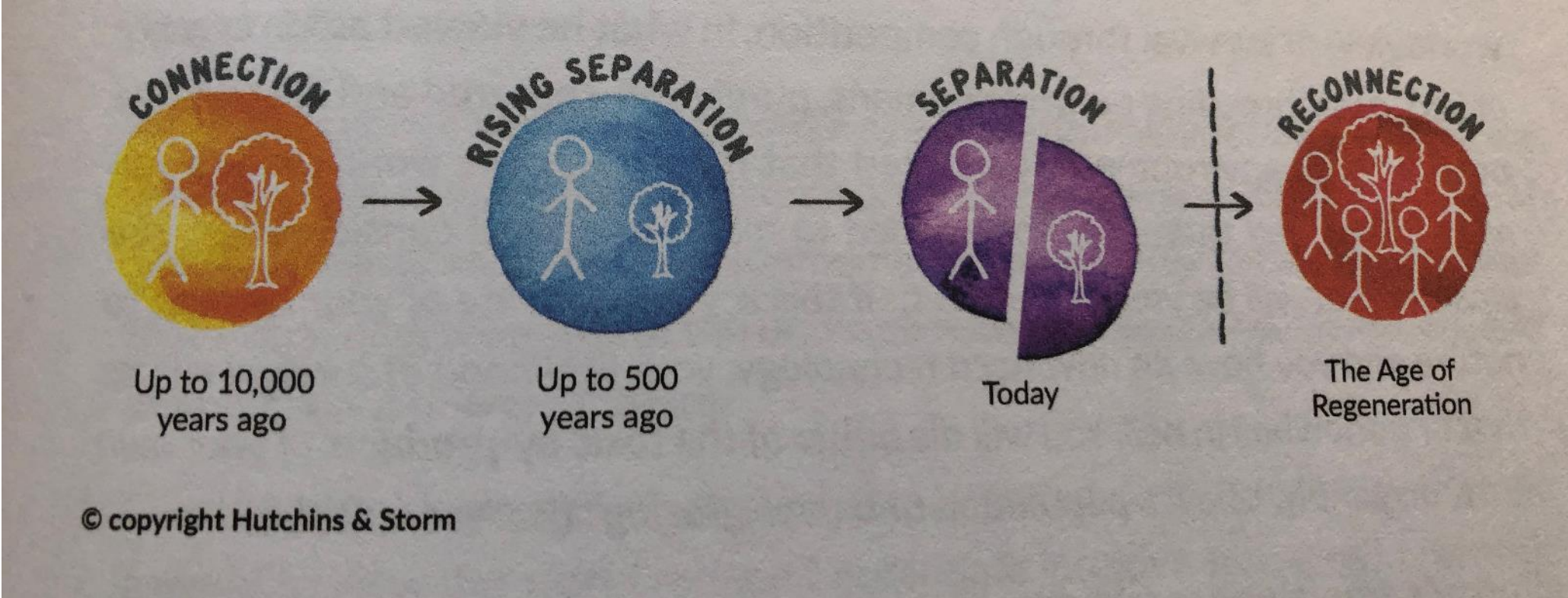
—Merriam-Webster Dictionary

ECONOMICAL-ECOLOGICAL-SOCIAL
SUSTAINABILITY

REGENERATIVE Agriculture

Resilient agro-ecosystems **conducive to life** that contribute to **regenerating** biodiversity, soil fertility, cyclical processes in plant growth that have been lost with the “green revolution”

Journey of Reconnection



Pilot Case Banana

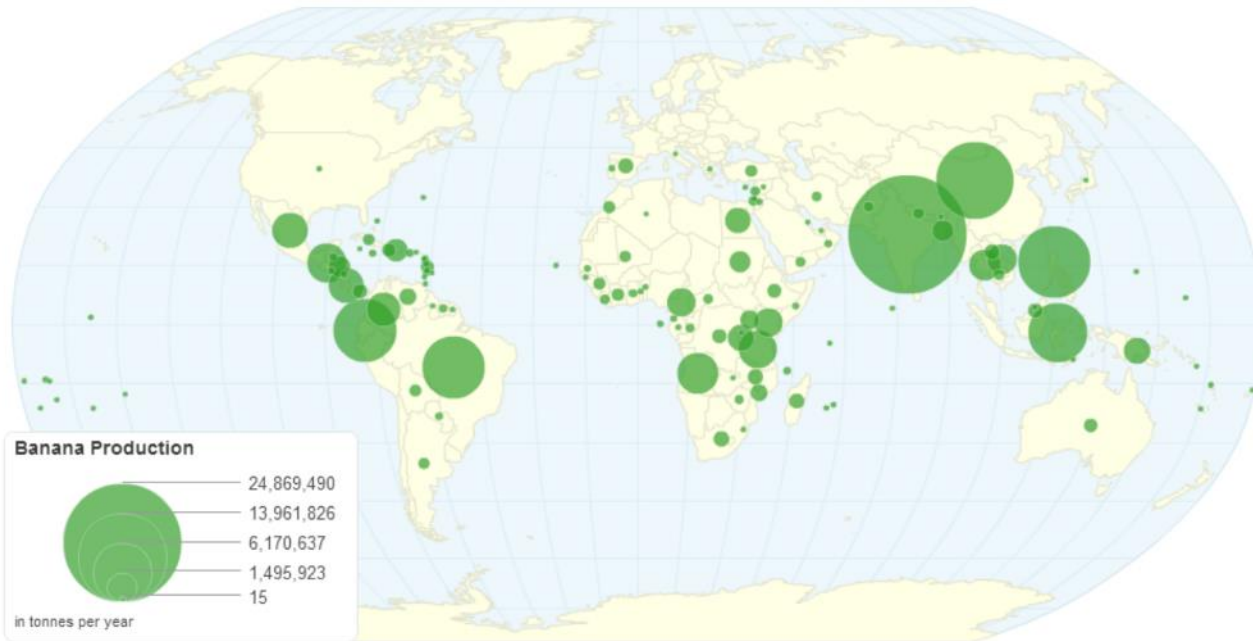
Why Banana?

4 staple food crop that feeds >400 Mio people in the Tropics

13% produced for export of which 75% concentrated in LATAM



Banana Production (tonnes)



Important food and income for small-scale farmers



In the Tropics lies huge potential to improve sustainability in conventional systems



Ecuador: New research on pesticide exposure

Ecuador is the third largest producer of cut flowers in the world, primarily roses, many of which are destined to be sold for Mother's Day. The industry employs more than 103,000 people, and relies heavily on agricultural pesticides.

In a paper published in the May 2017 issue of the journal *NeuroToxicology*, researchers at the University of California San Diego School of Medicine, with colleagues in Ecuador and Minnesota, have found altered short-term neurological behaviors in children associated with a peak pesticide spraying season linked to the Mother's Day flower harvest. This study examined children who did not work in agriculture but who lived in agricultural communities in Ecuador.

"Our findings are among the first in non-worker children to suggest that a peak pesticide use period (the Mother's Day flower production) may transiently affect neurobehavioral performance," said first author Jose R. Suarez-Lopez, assistant professor in the Department of Family Medicine and Public Health at UC San Diego School of Medicine.

"Children examined sooner after the flower harvest displayed lower performance on most measures, such as attention, self-control, visuospatial processing (the ability to perceive and interact with our visual world) and sensorimotor (eye-hand coordination) compared to children examined later in a time of lower flower production and pesticide use."



Banana (*Musa* spp.) as giant tropical grass

- Perennial (farm life 15-20 years) – continues harvest-soil regeneration
- Plant resists low tech growing – huge potential for full growing potential
- **Highly responsive and dependent on plant growth micro-organisms (PGPRs, AMF)**





Working principles:

1. Partner with **innovative growers**
2. **Bottom-up**: identify and prioritize grower's bottlenecks
3. Define **value** related parameters (QC standards)
4. **CO-DEVELOP** through comparative science-based (semi) field trials in a commercial setting (relevant for production reality)
5. Obtain **tangible results** on pre-defined value related parameters = VALUE for the farmer
6. Select **CONTEXT COMPATIBLE** solutions:
 - Economically feasible
 - Biologically suited for the environment
 - Applicable in current growing practices
 - Regionally sourced (logistics and biological compatibility)

Bottlenecks prioritized by farmer

1. Black Sigatoka - *Mycosphearella fijiensis*
2. Crown rot - *Thielaviopsis*, *Fusarium* spp.
3. Thrips – *Chaetanaphothrips signipennis* – *Frankliniella parvula*
4. Better nutriënt uptake
5. Mealybugs and scales
6. Plant- parasitic nematodes
7. Weed management
8. Intercrops als bankers for BCAs

1. Black Sigatoka control : banana's most important fungal disease

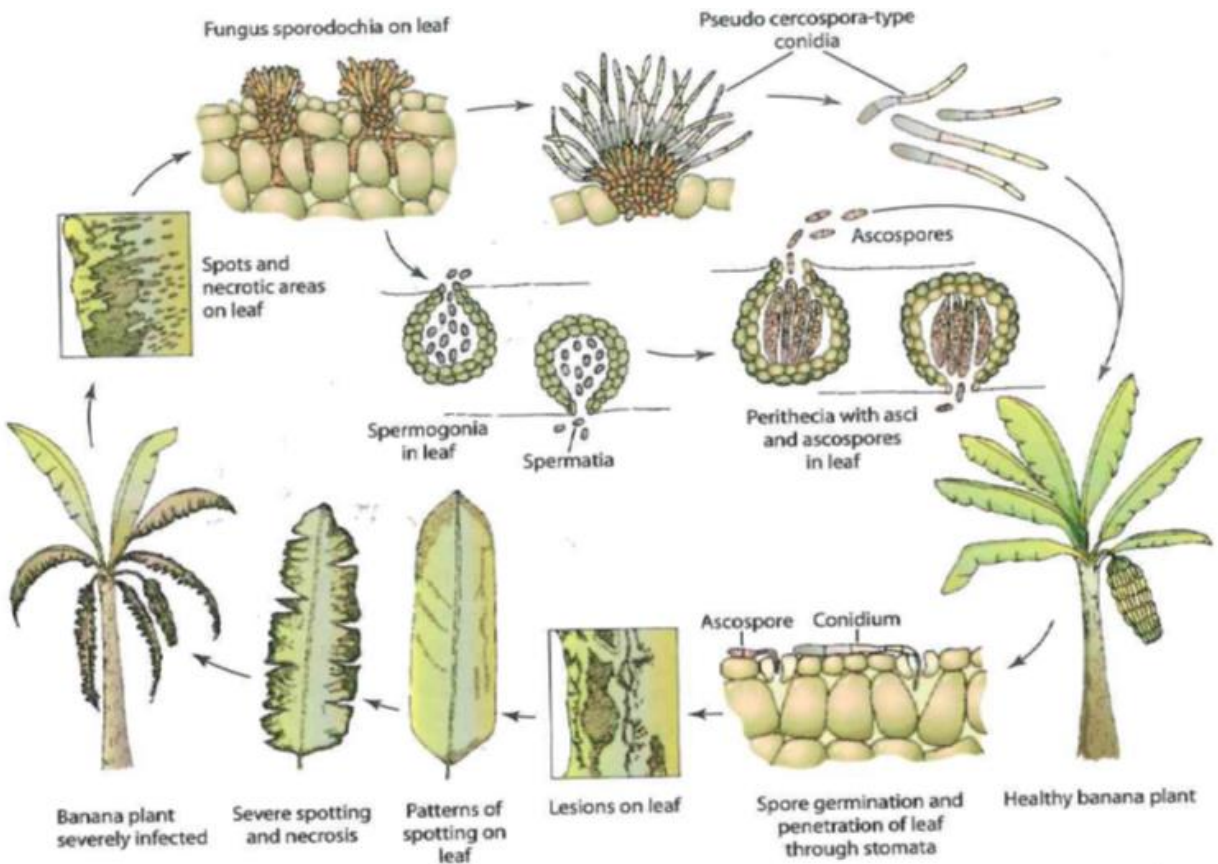
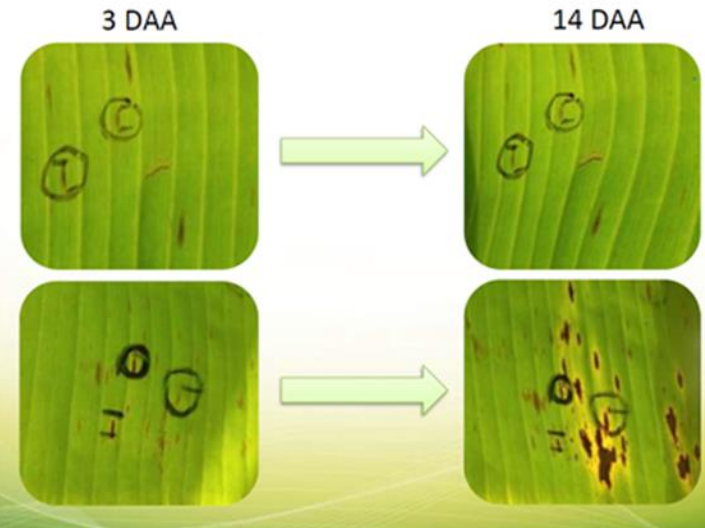
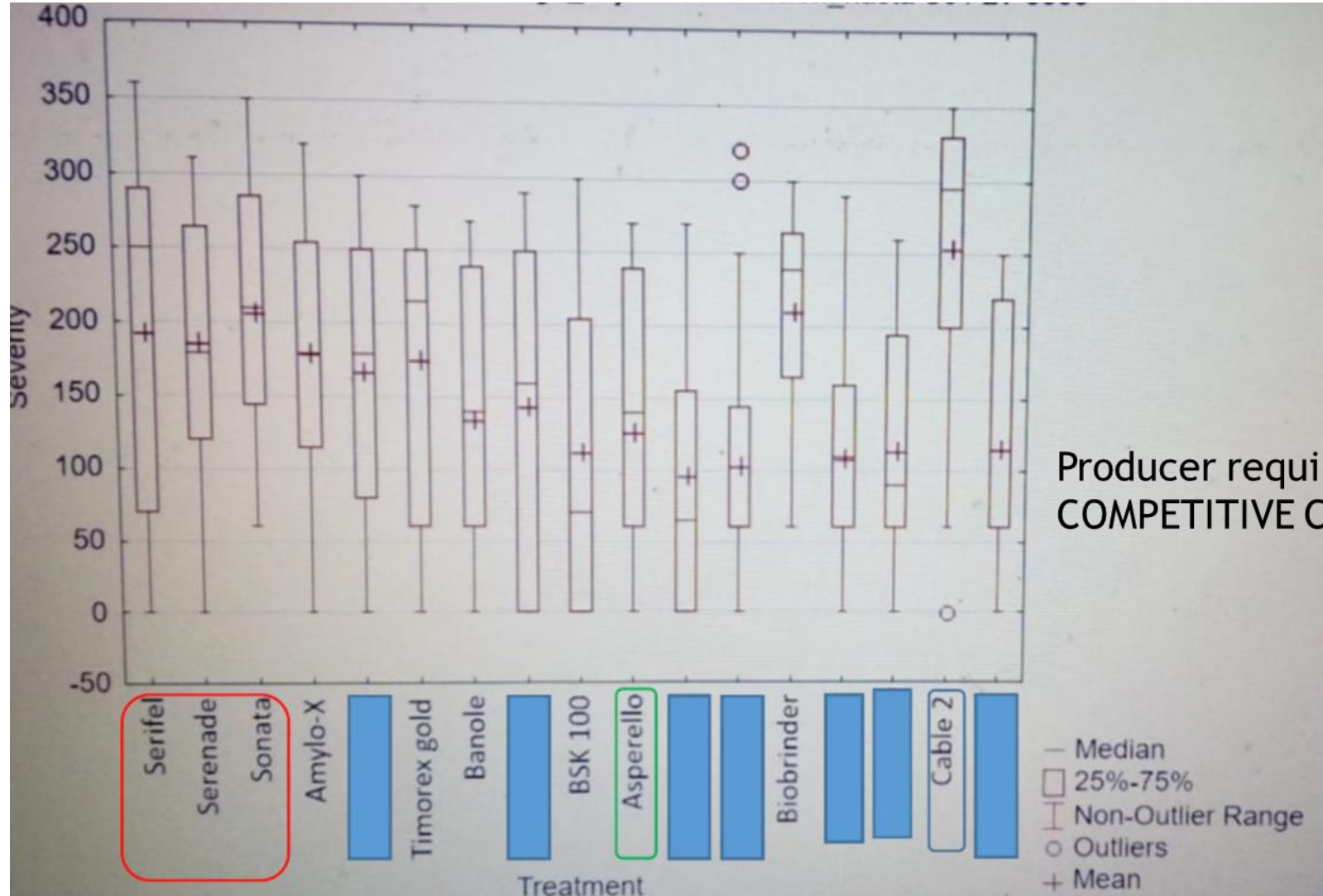


FIGURE 11-57 Development of Sigatoka disease of banana caused by *Mycosphaerella musicola* or *M. fijiensis*.

1. Black Sigatoka control (30 wks)



1. Black Sigatoka disease severity (30 wks)



Producer requires efficient product @
COMPETITIVE COST

20

48

14

30

80

0

= Cost(USD/Ha)

2 Crown rot control

- **Causal agents:** disease complex:
- *Thielaviopsis*, *Fusarium* spp., *Colletotrichum*.
- Data on local causal agent enabled the Selection of specific BCA's

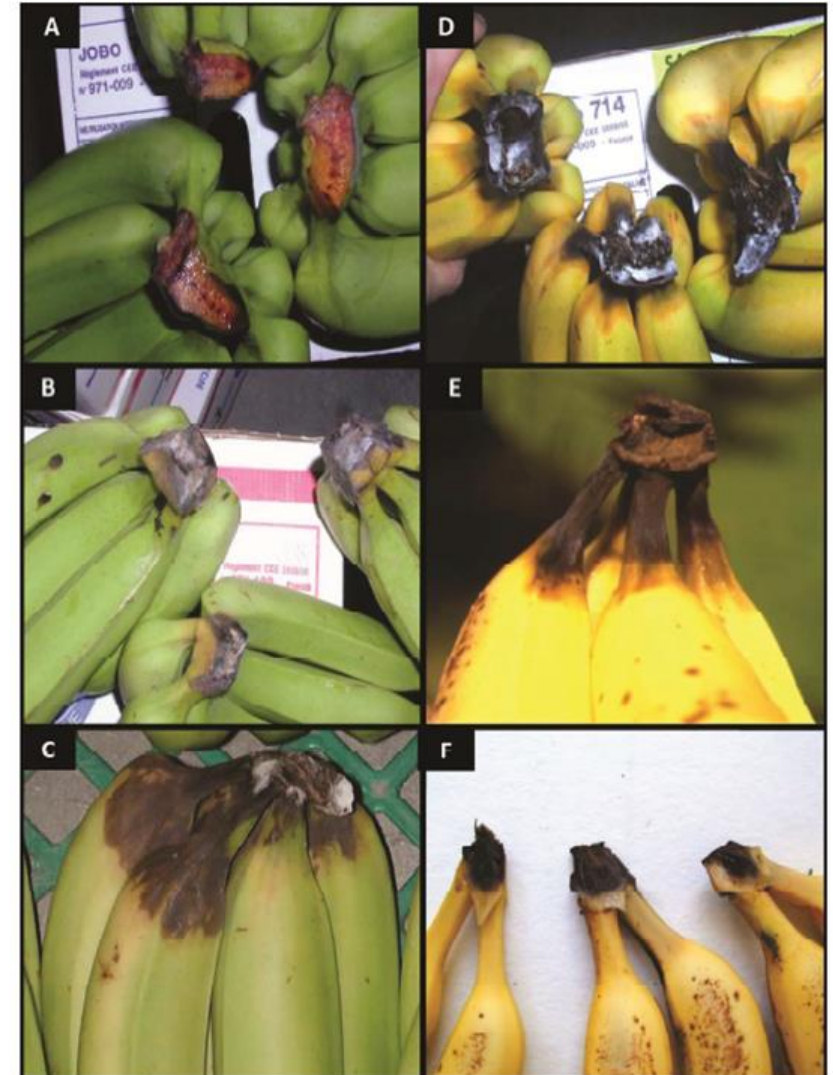


Fig. 1. Crown rot symptoms. A, Healthy crowns after maritime shipping before being placed in ripening rooms. B, Crowns diseased with a superficial mycelium after maritime shipping. C, Rot noted on bananas after maritime shipping. D, Rot on the peduncles inducing banana ripening upon their arrival after maritime shipping. E, External crown rot symptoms after fruit ripening. F, Internal crown rot symptoms after fruit ripening.

2 Crown Rot control

- **Trials (2) packing station:** commercial handling except for 'camera de fumigacion' 1 hand/treatment stored at ambient temperature



2 Crown Rot control Results



- MBCA 2



- MBCA 2 + sealing agent



- Control

2 Crown Rot control container results

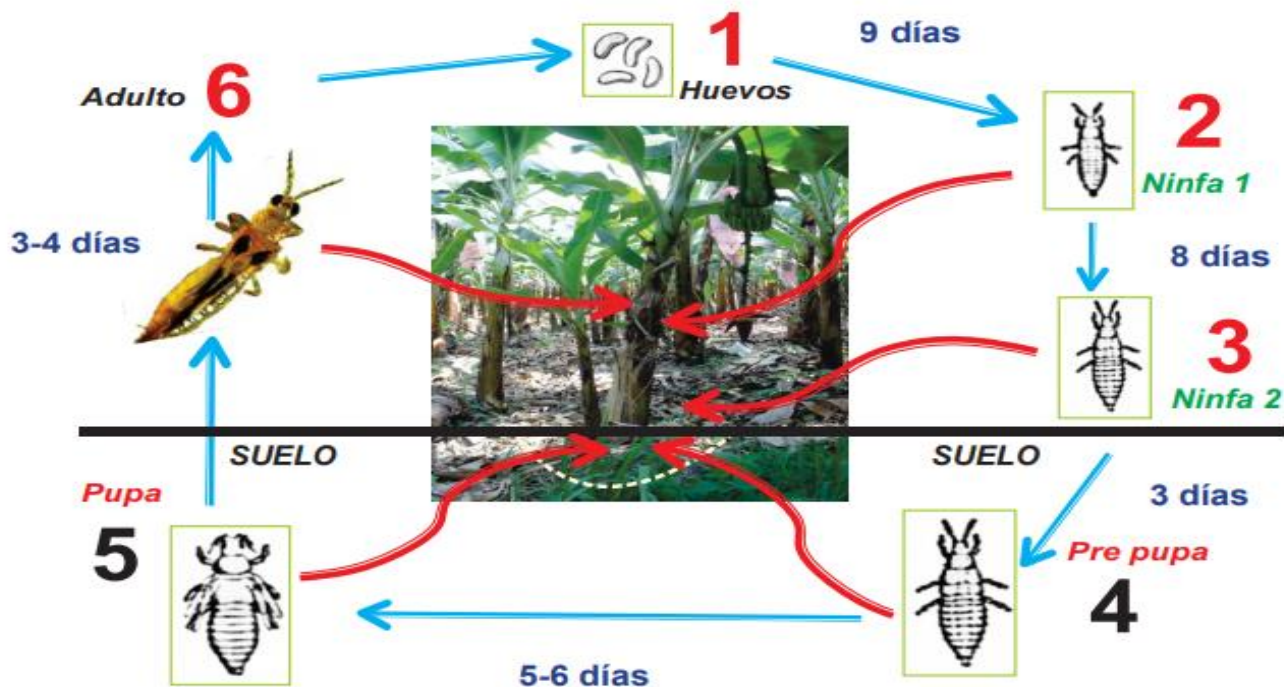


Ensayo de contenedor						
Codigo	Tratamiento	Concentracion	# cajas*	cajas con pudricion de corona	Manos afectadas	Calidad promedia**
control	120cc agua		9	5	35	82%
T1	Cicatrizante	12.5 ml/l+	9	4	25	89%
T2	Cicatrizante+ consortio de microbianos	12.5 ml/l+1.25g/l	9	5	35	88%
T3	Cicatrizante + Trichoderma	12.5 ml/l+5ml/l	9	1	8	94%
T4	Consortio de microbianos	1.25g/l	9	2	12	95%
*promedio de 17 manos/caja						
**tomando en cuenta todo parametros de calidad						



Confirmed after 21 container shipment with elevated temperature

3. Banana Rust Thrips control by beneficial insects



Frankliniella parvula symptoms



Frankliniella parvula

Oviposition in banana skin
Feed on pollen (flowers)



Chaetanaphothrips orchardii (banana rust thrips)



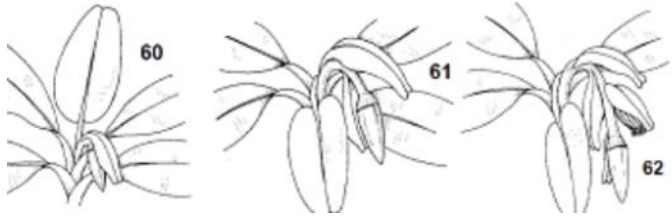
Chaetanaphothrips orchardii (banana rust thrips)

Pupation in soil
Weed management is essential!

• >65% yield loss due to rust thrips in organic banana!

3. Swirskii adults against Banana rust thrips

- Banana (n=75)



Moment of application

T1



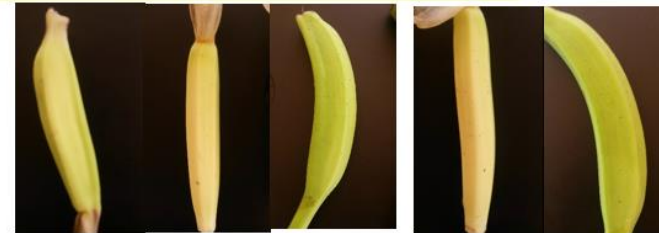
T2



50 adults



10/27/2022



Limpio

Leve

Moderado leve

Moderado

Fuerte

3. Thrips damage at harvest (14-12 WAA)

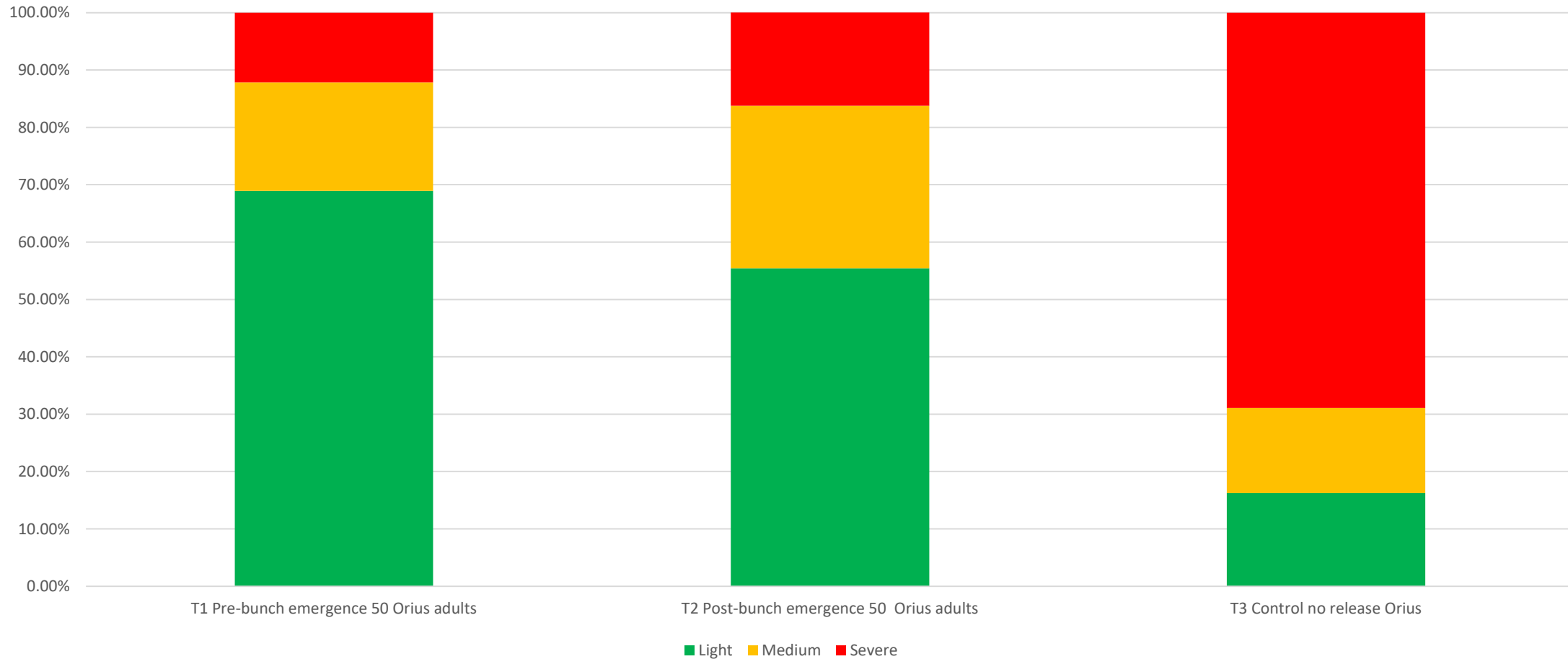
Banana *Musa* AAA G. Naine (n=75)

T1

T2

Control

Thrips damage levels 10 wks after Orius/Swirkii release (50 adults) (n=75)



4. microbials for (root) growth promotion in Williams/G Naine (Musa AAA)

- Preliminary trial (1), 2L bag trials (3), Field trial (1)
Lele

Microbial root bath



Drench



4. Plant growth promotion Conclusions

Nursery: growth promotion/rooting: higher fresh shoot and root growth
(+30% FSW and +20% FRW)

Field application: frequent applications via fertigation

3 years later: less black Sigatoka pressure in N bacteria treated plots



5. *Fusarium oxysporum* pv. cubense TR4

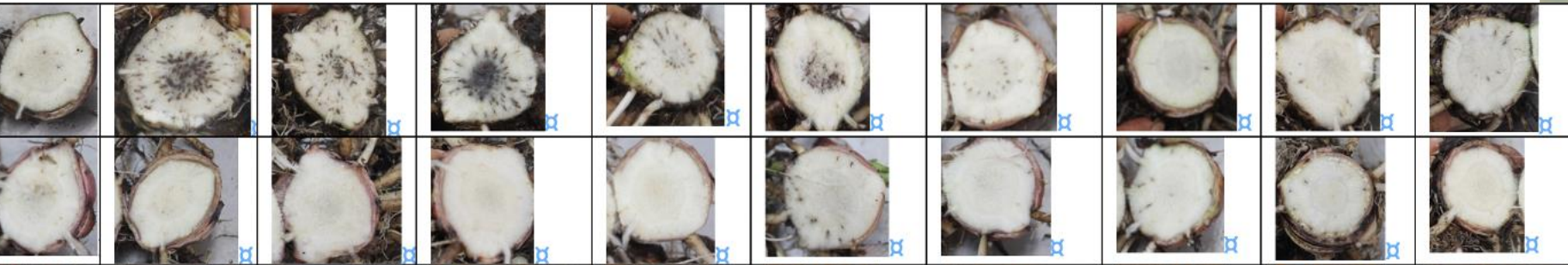


Catalysator for transistion
towards sustainable banana
cropping systems?

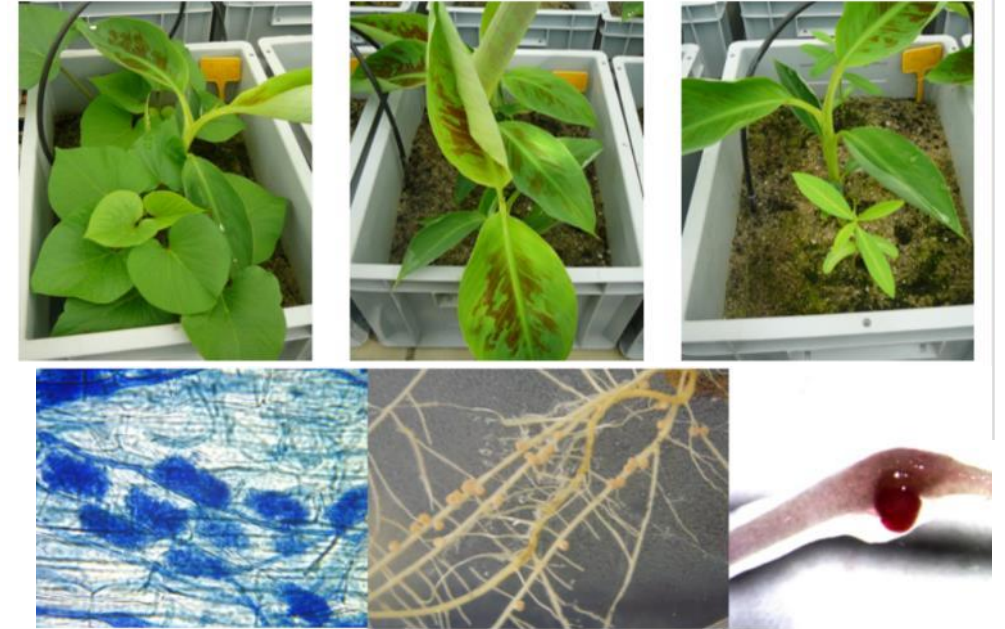
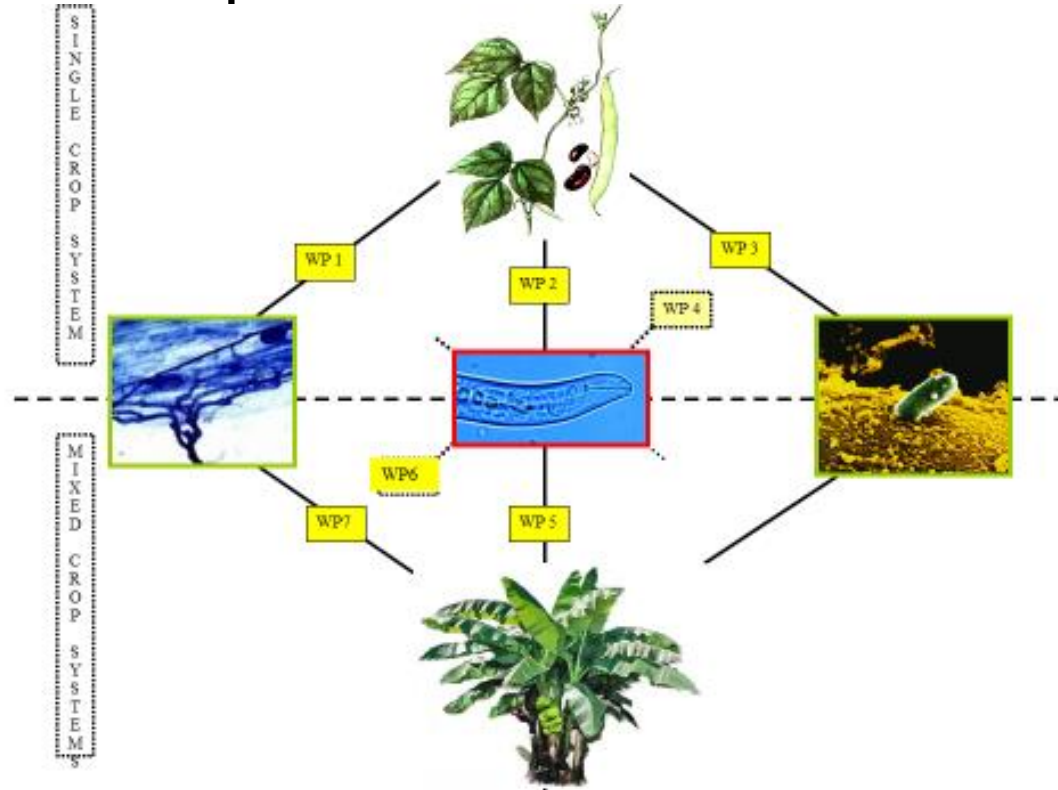


BC perspectives in incurable plant diseases

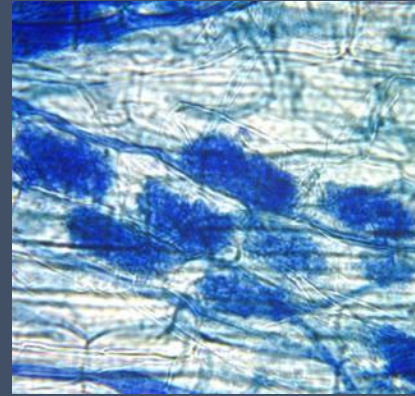
- (Semi)Field work on banana
- FOC TR4 testing with biocontrol agents



6. Multi-purpose intercrops (AMF, Rhiz.) for weed and plant parasitic nematode management

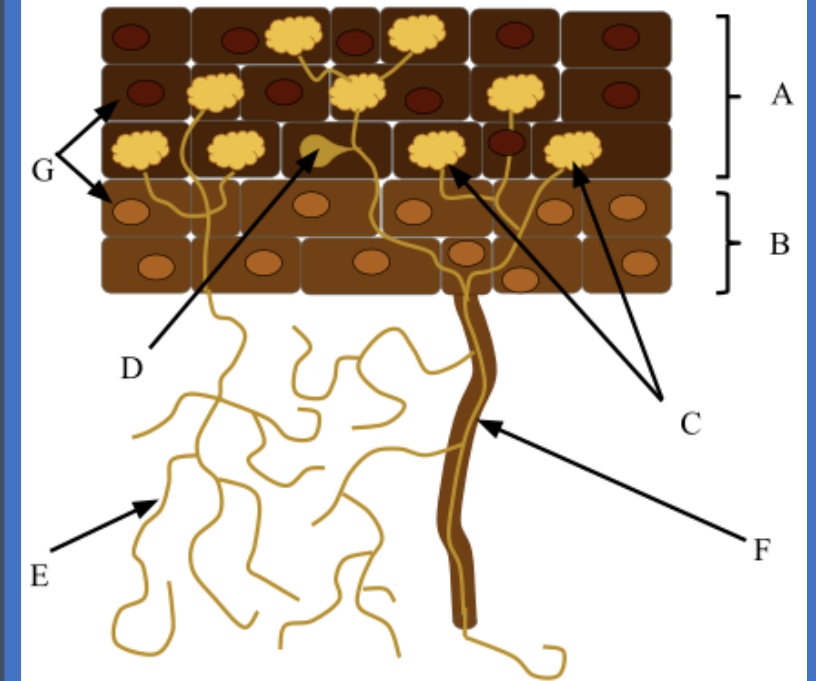
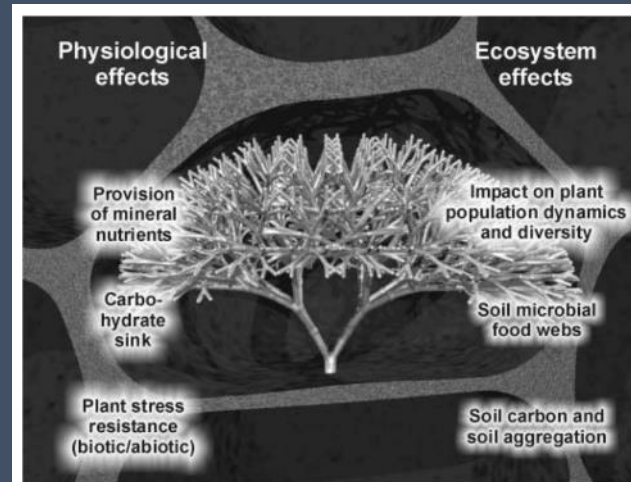


AMF: role for the plant



PHYSICAL EXTENSION ROOT EXCHANGE ZONE

(5mm to 70cm)

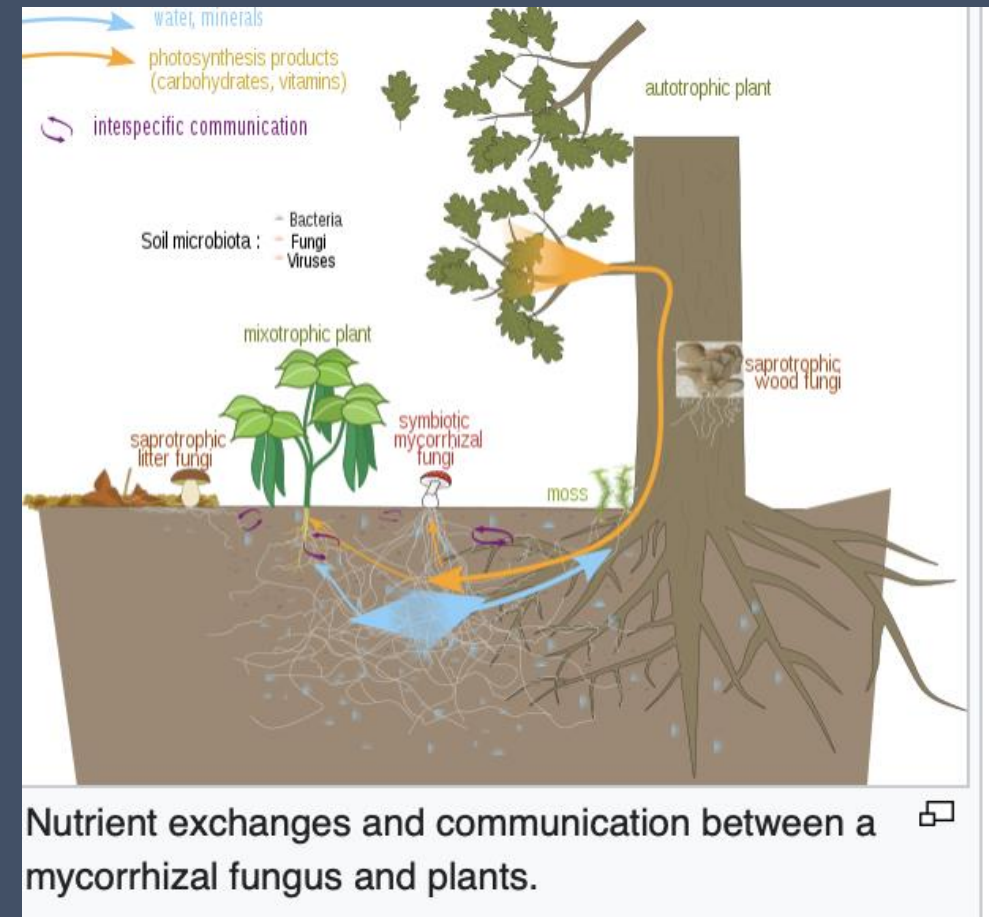


In this mutualism, fungal hyphae (E) increase the surface area of the root and uptake of key nutrients while the plant supplies the fungi with fixed carbon (A=root cortex, B=root epidermis, C=arbuscule, D=vesicle, F=root hair, G=nuclei).

AMF: role in the cropping system

INTERNET AND DELIVERY OF PLANTS

- Exchange of photosynthetic products for nutrients (P) and water
- Extra hyphal network: signalling (ISR)
- Glomalin = glue for soil aggregates
- Extra hyphal exudates feed soil life
- Role of mycotrophic plants as INTERCROPS



Plants build soil

CARBON SEQUESTRATION - HOW IT WORKS

1 PHOTOSYNTHESIS

During photosynthesis, plants convert carbon dioxide (a gas) into sugar (carbohydrate molecules).

2 NUTRIENT EXCHANGE

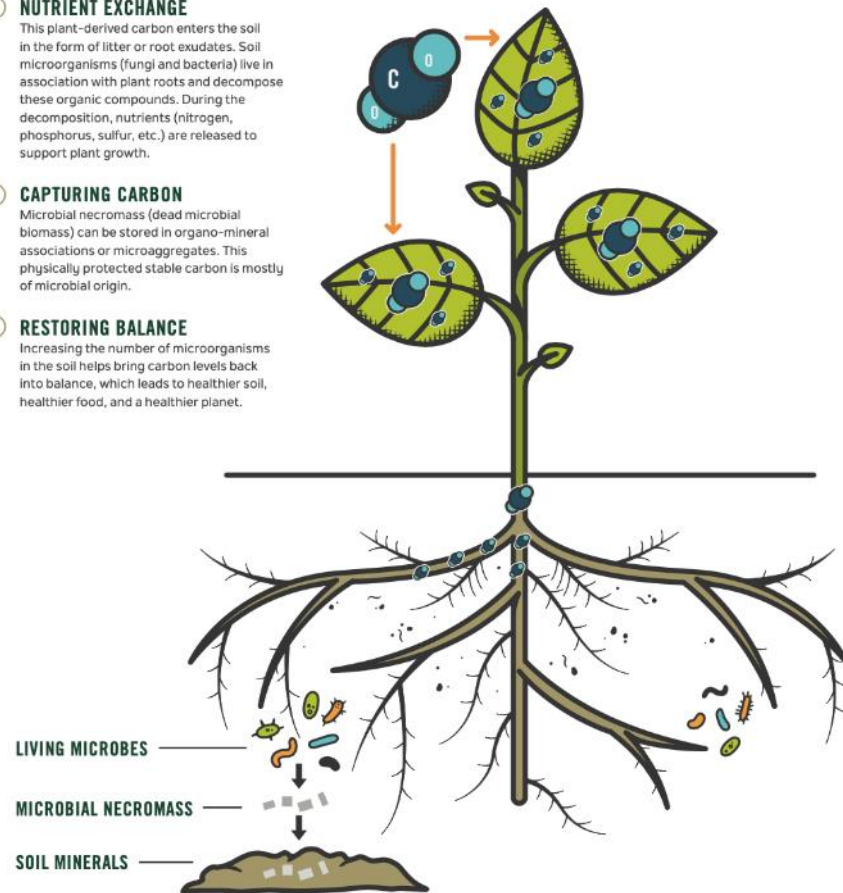
This plant-derived carbon enters the soil in the form of litter or root exudates. Soil microorganisms (fungi and bacteria) live in association with plant roots and decompose these organic compounds. During the decomposition, nutrients (nitrogen, phosphorus, sulfur, etc.) are released to support plant growth.

3 CAPTURING CARBON

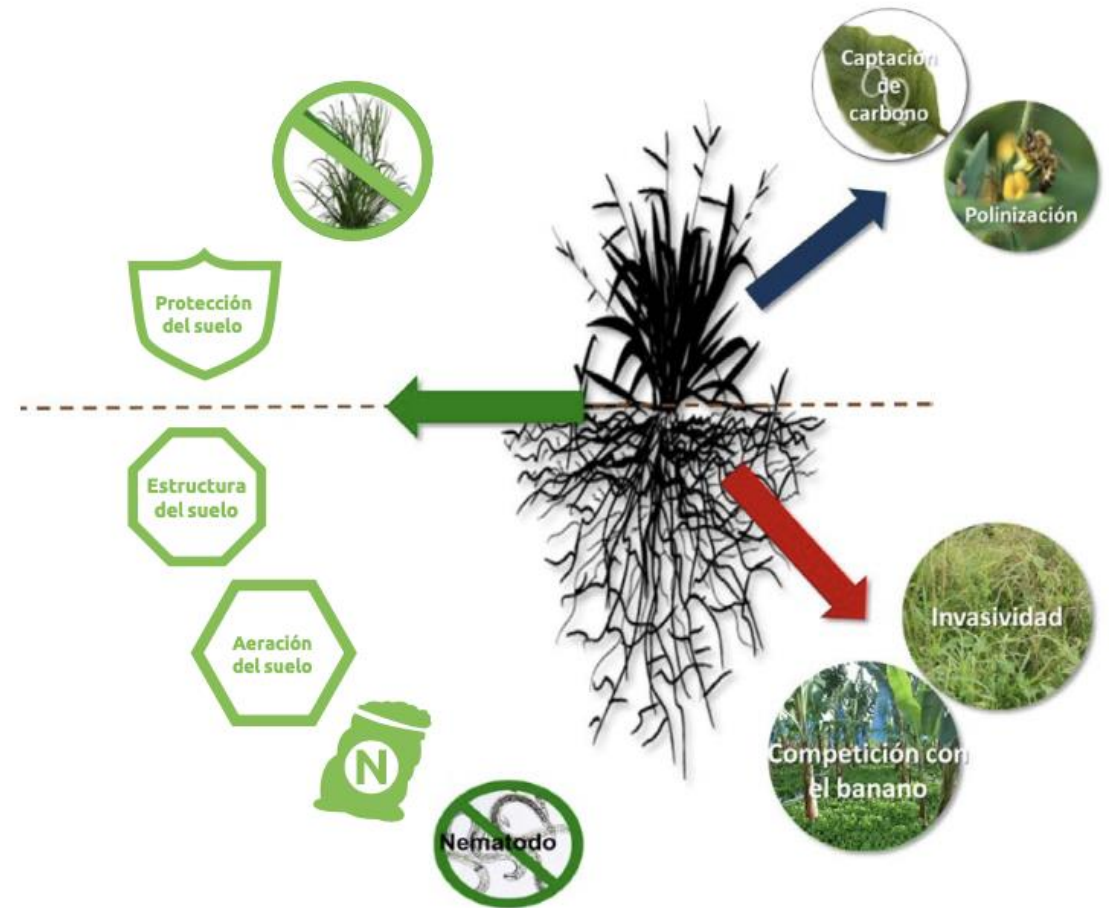
Microbial necromass (dead microbial biomass) can be stored in organo-mineral associations or microaggregates. This physically protected stable carbon is mostly of microbial origin.

4 RESTORING BALANCE

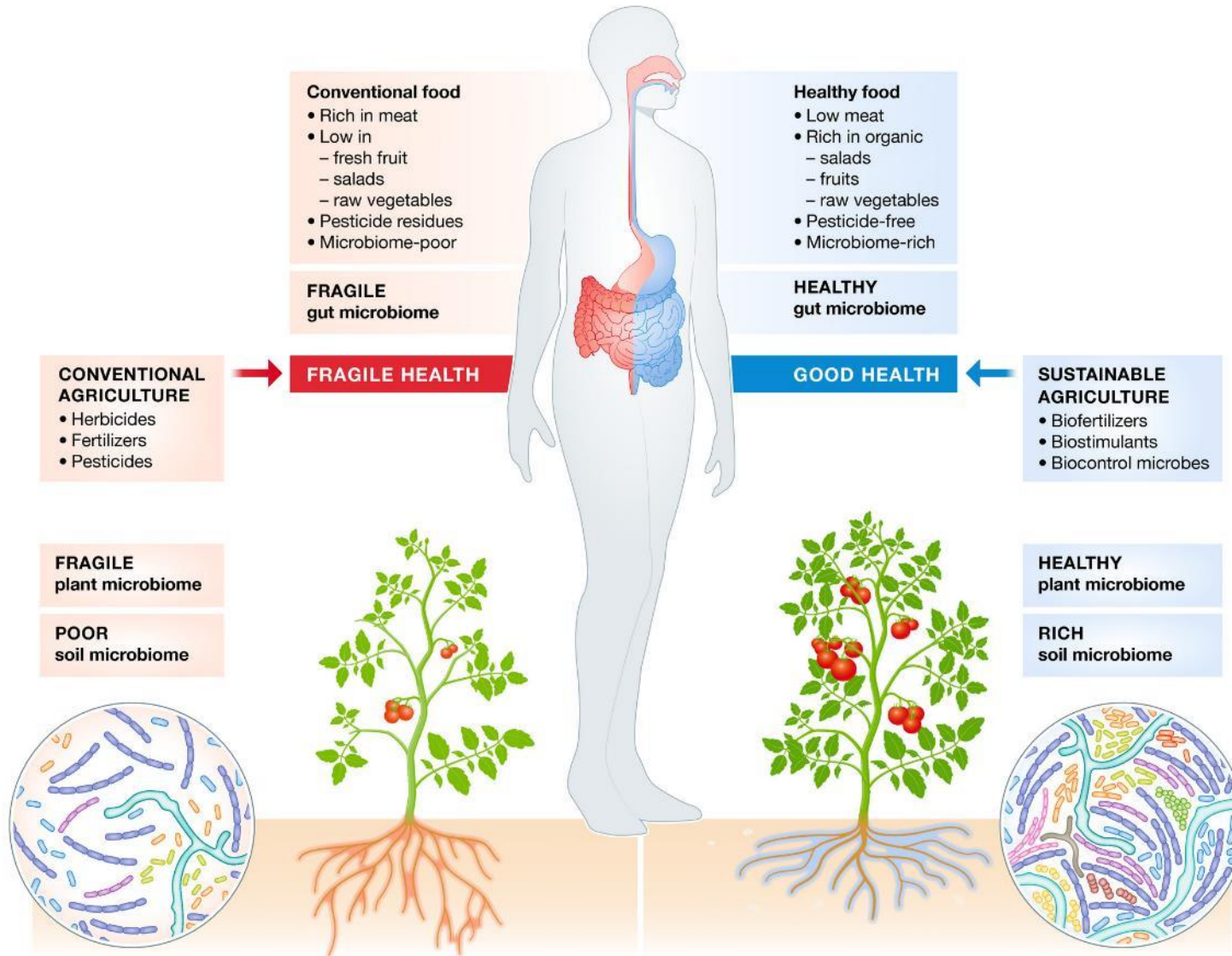
Increasing the number of microorganisms in the soil helps bring carbon levels back into balance, which leads to healthier soil, healthier food, and a healthier planet.



Los servicios apoyando a la producción



Healthy soils for healthy plants for healthy humans

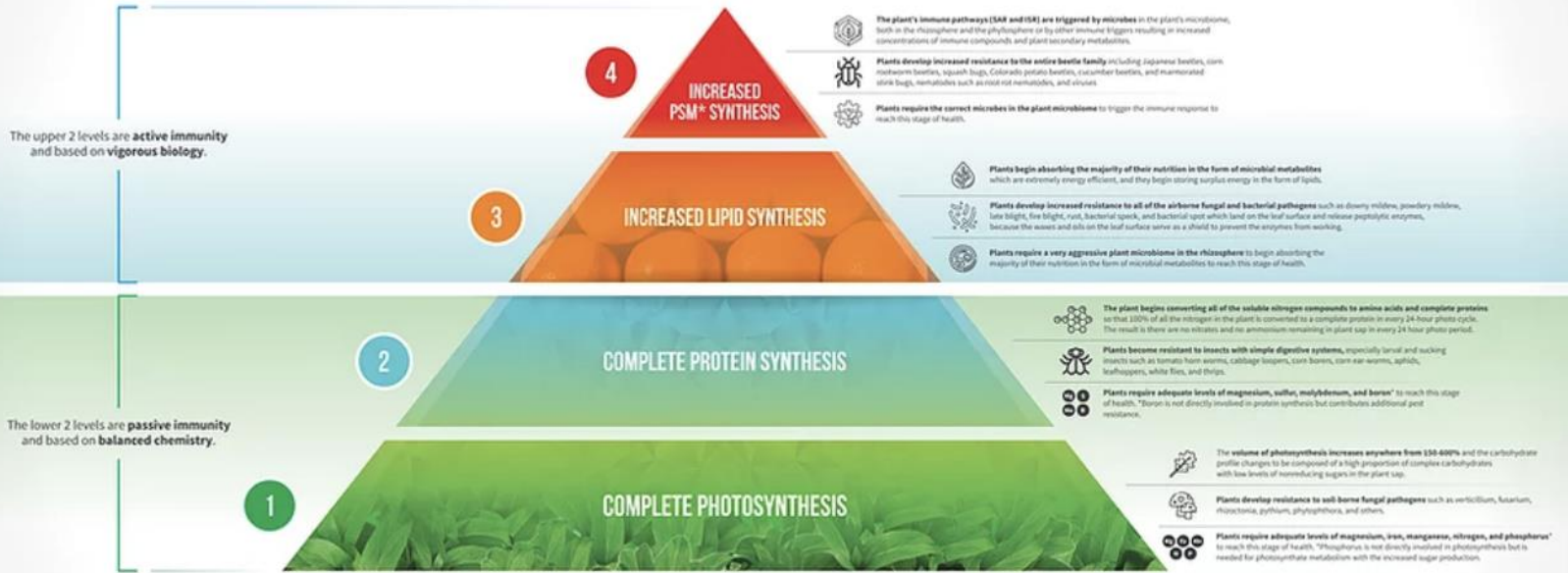


Microbial life is KEY

Heribert Hert, 2020

Plant Health Triangle Kempf

PLANT HEALTH PYRAMID



“Healthy plants can become completely resistant to diseases and insects.”

- John Kempf -

AdvancingEcoAg.com



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4 Increased Plant Secondary Metabolite synthesis

3 Increased lipid synthesis

2 Complete protein synthesis

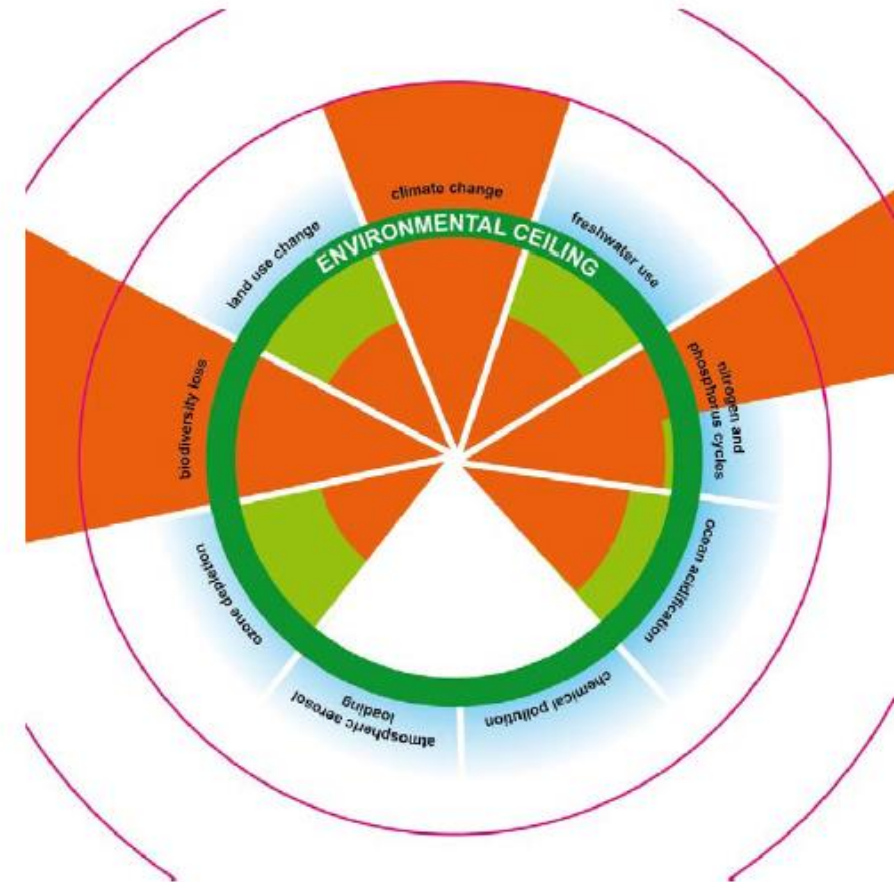
1 Complete photosynthesis

John Kempf developed this chart to describe how soils and crops transition towards complete pest and disease resistance as they achieve higher levels of health.

Biocontrol can address global challenges

- Biodiversity loss
- N,P cycling
- Climate change (C sequestration)

Figure 3. Breaching planetary boundaries

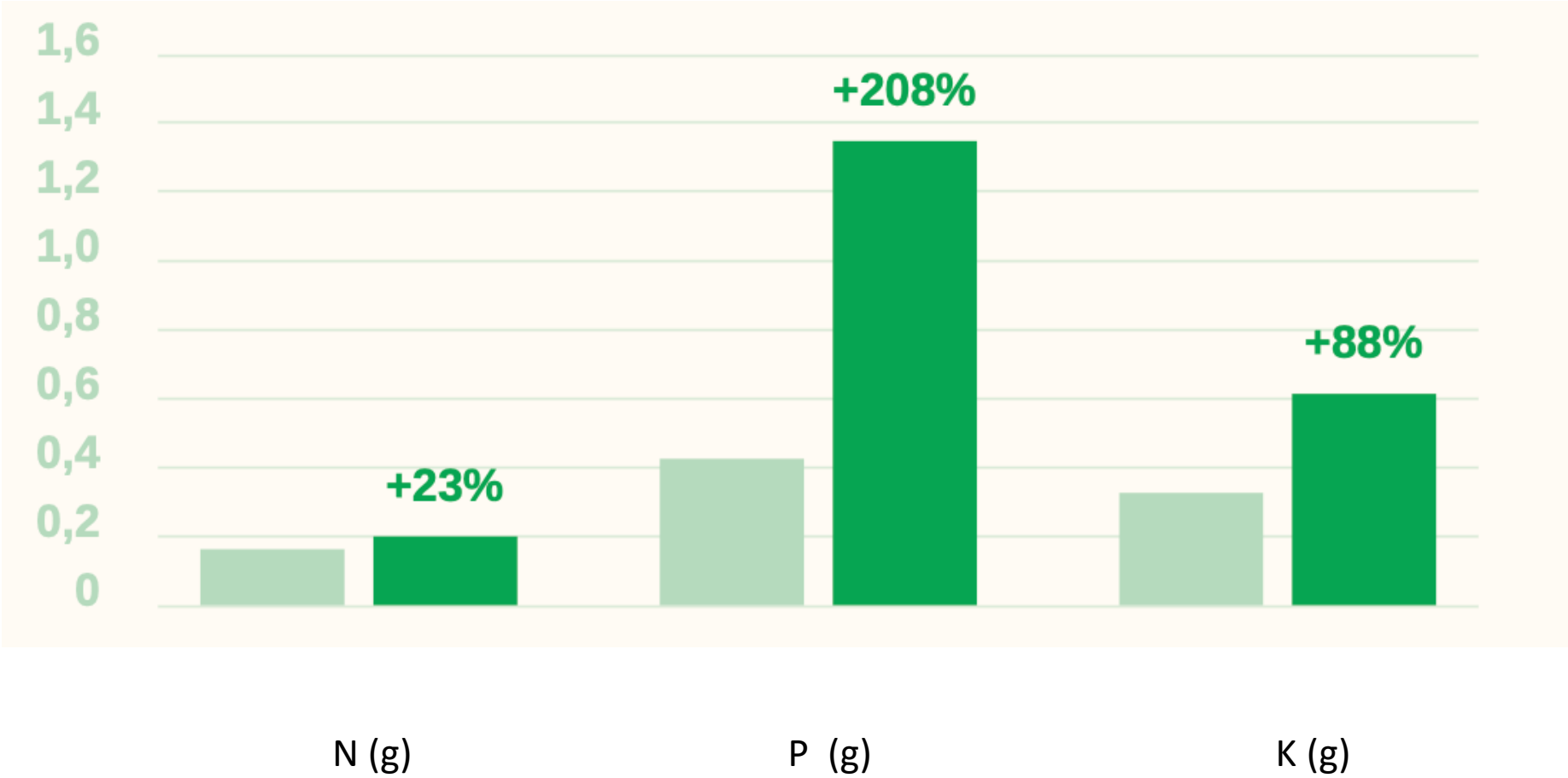


Source: Rockström et al (2009b), based on Table 2 above.

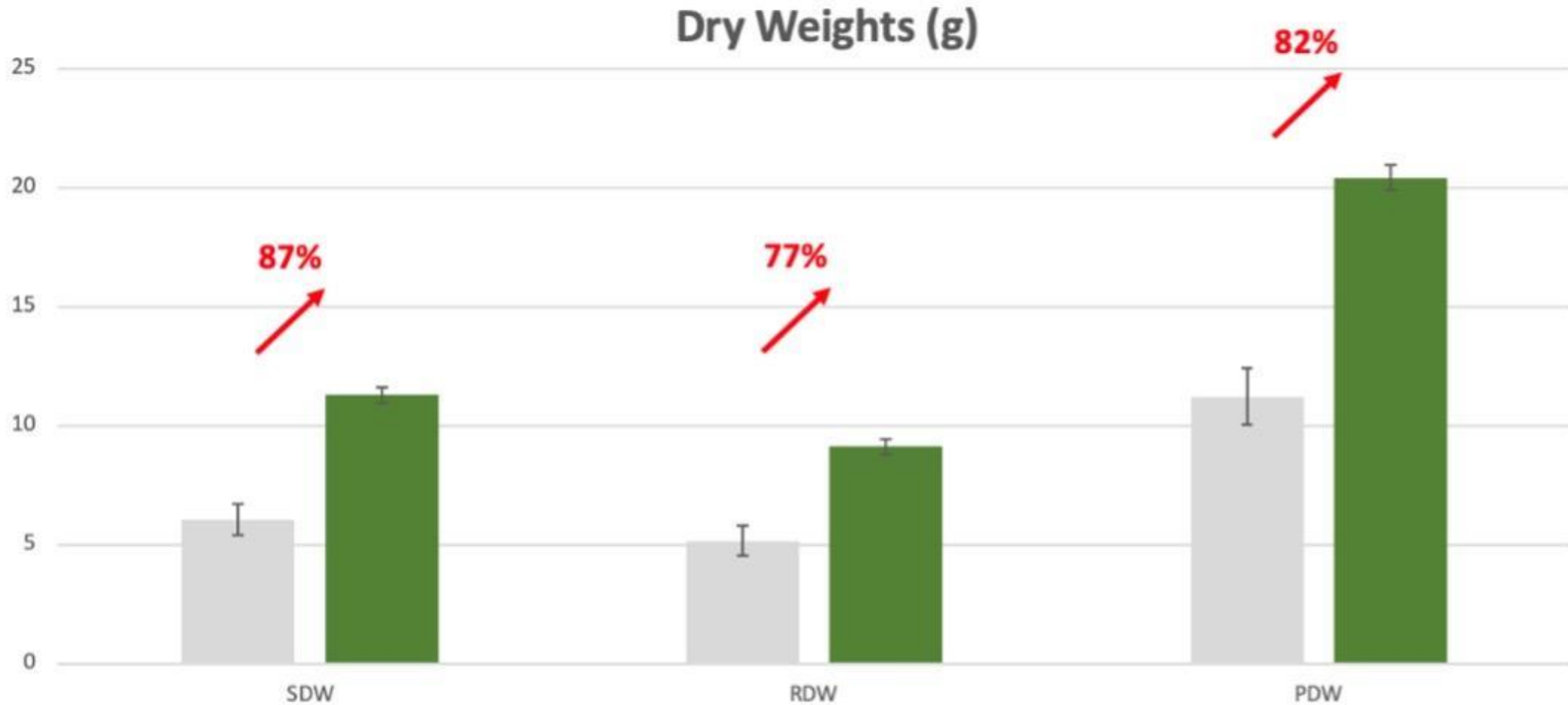
Restore biodiversity



Microbial mediated increased N,P, K accummulation



Increased plant growth (C accumulation)



Regenerative banana system

- Organized mixed plantation with several cash crops to ensure economical viability
- Multiple ICs based on ecosystem service you are looking for below and aboveground
- AMF inoculated banana-IC associated with beneficial micro-organisms (think N-P-K,)



Sustainable banana round table with food chain partners is formed





AHORRA UN 95% DE AGUA



Noticias ▼

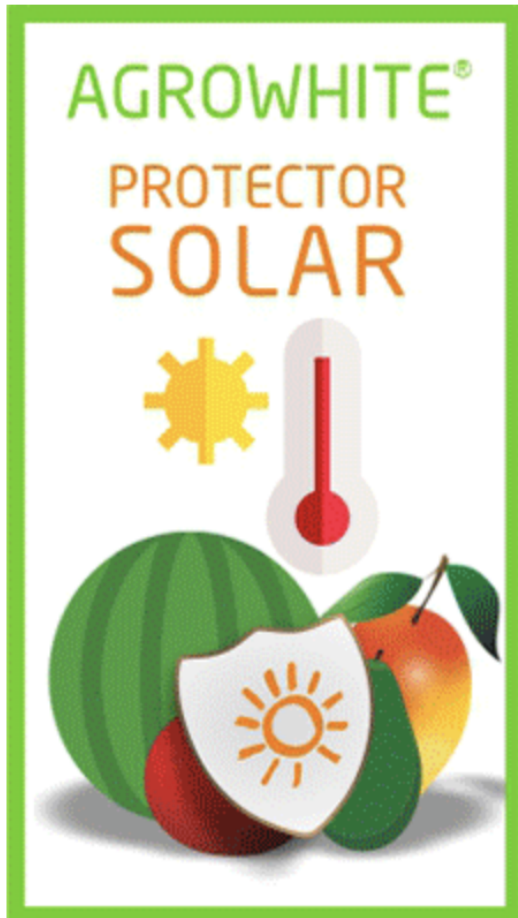
Buscar

Ofertas de trabajo

Fotos

Precios de mercado

Suscripción



Richard Salazar, director ejecutivo de Acorbanec:

“Estoy seguro de que los otros supermercados europeos van a sumarse a la mejora en la política de abastecimiento de bananos anunciada por Aldi”

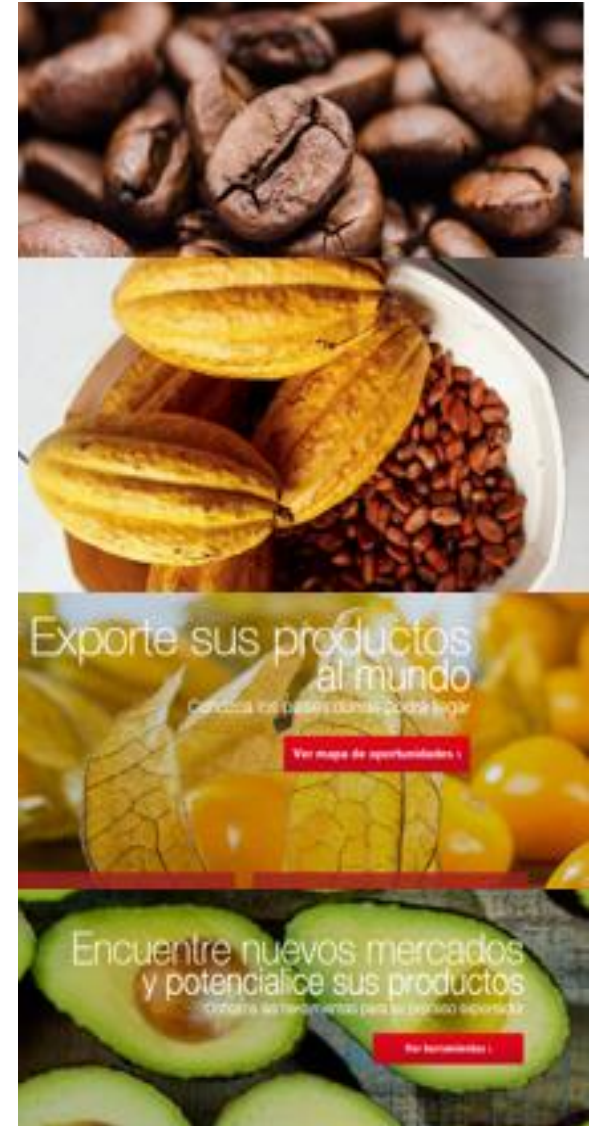
Tras meses de lucha por conseguir un compromiso de responsabilidad por parte del *retail* en Europa, el sector bananero latinoamericano celebra la decisión del supermercado alemán Aldi, que ha anunciado un paso adelante por una mayor sostenibilidad en su cadena de suministro de banano a través de la implementación de “prácticas de compra más responsables y aumentando aún más la transparencia de los costos de producción”, como detalla en su propia página web, mediante un abastecimiento que –adelanta– estará basado en la metodología Fairtrade.

“Los gremios de productores y exportadores de banano de Latinoamérica, a los que se unieron después los de la ACP y finalmente los productores europeos, hemos estado llevando a cabo esta petición conjuntamente. El pasado mes de marzo estuvimos en Bruselas, en el Parlamento Europeo y en la Comisión Europea, y también en Fruit Logistica en Berlín, donde nos reunimos con varios supermercados europeos para solicitarles esa responsabilidad compartida”, destaca Richard Salazar, director ejecutivo de Acorbanec.



Bridging Knowledge Gaps for the future

Hubs for generating knowledge on Biocontrol's potential
(in pre-competitive space) in major outdoor crops





THANKS to all our innovative farmers!





Farmers Empowered by Nature

Questions?

- Lieselot Van der Veken
- Lieselot@proterra-agro.com
- : +32475494026

Inspiration

Silent Spring-Rachel Carson

Cambridge Institute for Sustainability Leadership (CISL)

Regenerative Leadership

Biggest Little farm (7 yr documentary)

John Kempf Advancing Ecological Farming

The Soil will Save Us

Mycorrhizal planet

Active Hope